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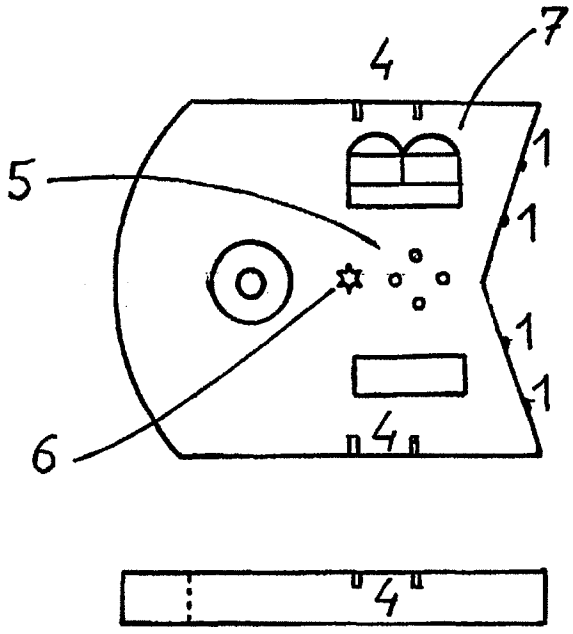
[Continúa en la página siguiente]

(54) Title: ELECTRONIC RECORD OF LUGGAGE, CARGO AND VEHICLES

(54) Título: REGISTRO ELECTRONICO DE EQUIPAJES, MERCANCIAS Y VEHICULOS



(57) Abstract: The invention relates an electronic record of luggage, cargo and vehicles comprising three elements: an interface, an interrogator and a spy. The interrogator and the spy form the mobile body of the record, while the interface constitutes the fixed body. Said interrogator and spy can be interconnected and communicate between them the data stored in the respective memories thereof. The interface is provided with a casing having a receptacle in which the other two elements can be housed once connected in order to load information by connecting said interface to the terminal of the company responsible for the transport of the luggage, cargo or vehicles. The main components appear in the diagram and comprise: female (1) and male (2) connectors, semi-circular channels (4) and pivots (3), pilot lamps (6), loudspeakers (5), digital portals (7) and a switch (8). The basic inventive model is used to keep a constant check on said luggage, cargo or vehicle, to which the interrogator is fixed respectively using an electromagnetic procedure. Meanwhile, the spy remains in the user's possession and the mobile body or interface, which is connected to the terminal, remains in the possession of the company. When a significant deviation from the planned itinerary occurs, the acoustic and visual alarm systems, which are integrated in the interrogator and the spy, are put into operation. In this way, all the incidents are recorded in the central system via the interface by means of the communication that is established immediately between the elements when said incident occurs.

[Continúa en la página siguiente]

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(84) **Estados designados** *(regional)*: patente ARIPO (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZM, ZW), patente euroasiática (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), patente europea (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE, TR), patente OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Publicada:
— *con informe de búsqueda internacional*

Para códigos de dos letras y otras abreviaturas, véase la sección "Guidance Notes on Codes and Abbreviations" que aparece al principio de cada número regular de la Gaceta del PCT.

(57) Resumen: El *REGISTRO ELECTRONICO DE EQUIPAJES, MERCANCIAS Y VEHICULOS* consta de tres elementos denominados *INTERFACE, INTERROGADOR Y ESPIA*. Los dos últimos constituyen el cuerpo móvil del Registro y el primero es el *cuerpo fijo. EL INTERROGADOR* y el *ESPIA* pueden acoplarse e intercomunicar entre ellos los datos almacenados en sus respectivas memorias. El interface consta de una carcasa con un receptáculo en el que pueden alojarse los otros dos elementos, una vez acoplados, para cargar información conectándolo a la terminal de la compañía encargada del transporte de los equipajes, las mercancías o los vehículos. Los componentes principales aparecen en el gráfico y pueden concretarse en: hembras (1) y machos (2) de conexión, pivotes (3) y canales semicirculares (4), pilotos luminosos (6), altavoces (5), portales digitales (7) e interruptor (8). La utilidad del modelo base es tener controlado en todo momento el equipaje, la mercancía o el vehículo a los que, respectivamente, se ancla por un procedimiento electromagnético el *INTERROGADOR*, quedando en poder del usuario el *ESPIA* y en el de la compañía, conectado a la terminal, el *cuerpo móvil* o *INTERFACE*. Cuando se produce una desviación significativa del itinerario previsto se ponen en funcionamiento los sistemas acústicos y visuales de alerta incorporados al *INTERROGADOR* y al *ESPIA*, recogiéndose todas las incidencias en el sistema central a través del *INTERFACE* data la comunicación que se establece de inmediato entre todos los

DESCRIPCIÓN

TÍTULO DE LA INVENCIÓN:

REGISTRO ELECTRÓNICO DE EQUIPAJES, MERCANCÍAS Y VEHÍCULOS J.M.R.2.

SECTOR DE LA TÉCNICA AL QUE SE REFIERE LA INVENCIÓN:

Se trata de un aparato que constará de diversos componentes característicos del Sector de la Electrónica diseñados y fabricados de forma expresa para el adecuado funcionamiento del conjunto. El proceso de almacenamiento de datos en sus distintos elementos se realizará mediante soporte informático con un *software* programado específicamente para cada uno de los diferentes modelos del Registro J.M.R.2.

OBJETO DE LA INVENCIÓN:

El citado aparato electrónico permitirá recoger en sus distintos elementos toda la información relativa al itinerario que debería seguir el equipaje, mercancía o vehículo cuyo registro se desea así como cuantos datos sean precisos del usuario y, en su caso, de la compañía encargada del transporte para poder realizar una permanente comprobación de la ruta seguida por aquéllos que hará factible conocer su situación en cada momento.

ANTECEDENTES DE LA INVENCIÓN:

Los solicitantes no tienen conocimiento de que en el actual estado de la técnica existan aparatos de características similares a la invención que ahora desean patentar. Nada tienen que ver con el Registro electrónico J.M.R.2. los *"buscapersonas"*

existentes en el mercado ni los instrumentos para *balizar* usados hasta el presente en navegación aérea y marítima. Todos ellos, además de utilizarse con fines diferentes, tienen diseño y funcionamiento obviamente distintos.

EXPLICACIÓN DE LA INVENCIÓN:

Consiste en un aparato compuesto por tres elementos diferenciados. Dos de ellos, denominados *INTERROGADOR* y *ESPÍA* forman el *cuerpo móvil* y pueden encajarse a presión mediante un sistema de hembras y machos que, además, posibilitan la interconexión para la transferencia electrónica de datos entre ambos elementos.

El tercero, denominado *INTERFACE* forma el *cuerpo fijo* que está constituido por un receptáculo en el que puede ser introducido el *cuerpo móvil*. En sus paredes laterales interiores contará con varios machos (habitualmente serán dos o cuatro) que se podrán acoplar a los canales semicirculares del *INTERROGADOR* y del *ESPÍA* para permitir el proceso de carga y transferencia de datos.

El *INTERFACE* dispondrá de un mecanismo para facilitar la expulsión de los elementos del *cuerpo móvil*. Además, su carcasa estará dotada de unos cables para conectar con el terminal de la compañía encargada del transporte. El *INTERROGADOR* y el *ESPÍA* contarán, cada uno de ellos, de un sistema de almacenamiento de la información así como de un doble mecanismo de comunicación (sonoro y visual).

El sonoro consistirá en un altavoz por el que se podrá emitir una señal acústica de alerta en caso de surgir desviaciones significativas sobre el itinerario previsto y, además, cuantos mensajes se estimen necesarios.

El visual estará compuesto de un piloto luminoso para señalizar las incidencias y de una ventanilla o *portal digital* dividido en dos secciones (una con fondo amarillo y dígitos en negro y otra, separada de la anterior, con fondo rojo y dígitos en negro).

BREVE DESCRIPCIÓN DE LOS DIBUJOS:

La FIGURA 1 representa la planta superior (encima) y uno de los alzados laterales (debajo) del primer elemento del *cuerpo móvil* del aparato, denominado *INTERROGADOR*. En ella se han señalizado las cuatro hembras de interconexión (1), los canales semicirculares (4), el altavoz (5), el piloto luminoso (6) y las dos secciones del *portal digital* (7).

La FIGURA 2 representa la planta superior (encima) y uno de los alzados laterales (debajo) del segundo elemento del *cuerpo móvil* del aparato, denominado *ESPÍA*. En ella se han señalizado los cuatro machos de interconexión (2), los canales semicirculares (4), el altavoz (5), el piloto luminoso (6), las dos secciones del *portal digital* (7) y el interruptor (8).

La FIGURA 3 representa la planta superior (izquierda) y el alzado del frente por el que se introduce el *cuerpo móvil (derecha)* en el tercer elemento o *cuerpo fijo* del aparato, denominado *INTERFACE*. En ella se han señalizado los machos (3) que pueden acoplarse con los canales semicirculares del *INTERROGADOR* y del *ESPÍA*, así como el piloto luminoso (6) que permitirá distinguir las distintas fases del proceso de carga o transferencia de datos y las diversas incidencias que pudieran acaecer.

Una de las paredes laterales del receptáculo del *INTERFACE* en el que se acopla el *cuerpo móvil* lleva grabadas en su parte superior las siglas J . M . R . 2. del Registro.

DESCRIPCIÓN DE UNA REALIZACIÓN PREFERIDA:

Dadas las características de la invención todos los modelos que pudieran fabricarse del Registro electrónico J.M.R.2. tendrán una configuración idéntica a la descrita en los dos apartados de esta Memoria: EXPLICACIÓN DE LA INVENCIÓN y BREVE DESCRIPCIÓN DE LOS DIBUJOS.

Las diferencias que pudieran existir entre unos y otros se limitarían, en primer lugar, a su tamaño (según se trate de bultos, maletas, baúles, etc., en el supuesto de los equipajes, atendiendo a los envases de las mercancías que incluso podrían ser contenedores y según las características de los vehículos), en segundo, a la naturaleza de los materiales con que se fabrique y, por último, según el volumen de información que en cada caso deba registrarse en la memoria de los distintos elementos que componen el Registro. No resulta, pues, necesario realizar la descripción completa de una realización específica dado que los elementos diferenciales entre los diversos modelos no son determinantes para describir de forma genérica sus componentes.

SOMERA EXPLICACIÓN DEL USO DE LA INVENCIÓN :

Para cargar de información el Registro se introducirá el cuerpo móvil dentro del receptáculo del cuerpo fijo o *INTERFACE*, debiendo estar acoplados los dos elementos del primero (*INTERROGADOR* y *ESPÍA*) y conectarse el *INTERFACE* mediante los correspondientes cables a la terminal de la compañía que deba controlar el movimiento del equipaje, la mercancía o el vehículo con el fin de introducir los datos que sean necesarios para poder comprobar en todo momento que la ruta de aquéllos no se desvíe significativamente del itinerario previsto.

Una vez introducidos los datos en las memorias de todos los elementos se extraerá el *cuerpo móvil* del *cuerpo fijo* separando a continuación los dos elementos del primero.

El *INTERROGADOR* se colocará en el equipaje, en la mercancía o en el vehículo con unos anclajes electromagnéticos especiales y el *ESPÍA* se entregará al usuario para que pueda retirar aquéllos en su destino.

El *INTERFACE* quedará en poder de la compañía y podrá seguir conectado a su terminal para transferir al *INTERROGADOR* y al *ESPÍA*, si es necesario, cuantas informaciones interese mientras se realiza el itinerario o cuando se producen desviaciones significativas del mismo.

Los carros o vehículos de recogida de los equipajes y mercancías al final de cada cinta transportadora o de cada terminal o muelle de carga así como los transportes o almacenes de vehículos mantendrán como señuelo parte de la información impresa en el cuerpo móvil del Registro para evitar que se disparen las alarmas del *INTERROGADOR* y del *ESPÍA*.

La transmisión de datos entre los distintos elementos del aparato, una vez separados éstos, se realizará habitualmente mediante señales de radio de frecuencia ciudadana aunque podrá trabajarse con otras frecuencias según convenga.

OBSERVACIONES FINALES:

PRIMERA: Para el funcionamiento del sistema de registro electrónico de equipajes, mercancías y vehículos podrán utilizarse elementos auxiliares ya existentes en el mercado, o, de forma prioritaria, los siguientes (también desarrollados por el mismo inventor): Batería de *impedancia simulada*, *larga duración* y no contaminante, *software* diseñado específicamente para los distintos modelos del registro según sea su uso y *selector automático* de la frecuencia de utilización adaptado a cada circunstancia de transporte.

SEGUNDA: Al sistema de registro electrónico de equipajes, mercancías y vehículos se le podrán incorporar elementos adicionales complementarios (ideados por el mismo inventor) para su utilización específica en transporte aéreo (dispositivo de bloqueo de los mandos manuales y paso automático a control desde tierra), transporte marítimo (localización de contenedores y bultos tras su caída accidental al mar o bien después de un naufragio), transporte terrestre (detección de la cantidad de alcohol por exhalación y bloqueo automático de los mandos del vehículo si se superan los límites permitidos legalmente, identificación del conductor por *cadenas de ADN* e información permanente de las incidencias al conductor y, en su caso, al equipo base de la compañía de transportes).
Así mismo podrán incorporarse a los registros otros dispositivos complementarios (del mismo inventor) que permitirán su utilización en Biología Marina (seguimiento del *fitoplancton* y control de bancos de especies marinas), en el montaje de *sistemas anticolisión* para los vehículos que circulen por autopistas, autovías o carreteras controladas y, por último, en el diseño y construcción de *autopistas inteligentes*.

REIVINDICACIONES

Seguidamente se relacionan las reivindicaciones que definen el objeto para el que se solicita protección:

1ª) Sistema de registro electrónico de equipajes, mercancías y vehículos que permite controlar el traslado y movimiento de los mismos caracterizado por constar de:

a) Un elemento, denominado *cuerpo móvil*, constituido a su vez por otros dos componentes, denominados *INTERROGADOR* y *ESPÍA*, capaces de acoplarse y posibilitar la conexión para la transferencia electrónica de datos entre ambos.
Cada uno de ellos cuenta con un sistema de almacenamiento de la información y con un mecanismo de comunicación.

b) Otro elemento, denominado *cuerpo fijo* o *INTERFACE*, capaz de acoplarse con el *cuerpo móvil* para permitir el proceso de carga y transferencia de datos disponiendo de cables en su carcasa para conectar con el terminal de la compañía encargada del transporte.

También se caracteriza porque, para el funcionamiento y control de dicho sistema se realizan, en general, las siguientes operaciones:

a) Se acoplan, previamente, los dos elementos del *cuerpo móvil* (*INTERROGADOR* y *ESPÍA*) y el conjunto se acopla al *cuerpo fijo* (*INTERFACE*) conectando éste último, mediante los correspondientes cables, con el terminal de la compañía que deba controlar el movimiento de los equipajes, las mercancías o los vehículos en el que quedarán registradas cuantas incidencias se produzcan y tener permanente localizados cada uno de ellos.

b) Se introducen los datos necesarios en los *cuerpos fijo y móvil* para poder comprobar en todo momento que el INTERROGADOR no se desvía significativamente del itinerario previsto.

c) Una vez introducidos los datos en las memorias de todos los elementos se extrae el *cuerpo móvil* del *INTERFACE* separando, a continuación, los dos elementos del primero (*INTERROGADOR* y *ESPÍA*).

d) Se coloca el *INTERROGADOR* en el equipaje, la mercancía o el vehículo con unos anclajes electromagnéticos especiales y el *ESPÍA* se entrega al usuario para que pueda retirar aquéllos en su destino.

e) El *INTERFACE* queda en poder de la compañía encargada del transporte y podrá seguir conectado a su terminal para transferir al *INTERROGADOR* y al *ESPÍA*, si es necesario, cuantas informaciones interese mientras se realiza el itinerario o para detectar cuando se produzcan desviaciones significativas del mismo.

2ª) Sistema de registro electrónico de equipajes, mercancías y vehículos (según reivindicación 1ª) caracterizado porque el acoplamiento entre *INTERROGADOR* y *ESPÍA* se realiza encajando a presión ambos mediante un sistema de hembras y machos que, además, posibilitan la conexión para la transferencia electrónica de datos entre ambos componentes del *cuerpo móvil*.

3ª) Sistema de registro electrónico de equipajes, mercancías y vehículos (según reivindicación 1ª), caracterizado porque el *cuerpo fijo* está constituido por un receptáculo en el que puede ser introducido el *cuerpo móvil* y porque dispone en sus paredes

laterales interiores de varios machos que se pueden acoplar a los canales semicirculares de que disponen el *INTERROGADOR* y el *ESPÍA* para realizar el proceso de carga y transferencia de datos entre los dos cuerpos.

4ª) Sistema de registro electrónico de equipajes, mercancías y vehículos (según reivindicación 1ª) caracterizado porque el mecanismo de comunicación entre el *INTERFACE* y el cuerpo móvil y entre las dos componentes de éste último se detecta en formas sonora y visual.
El *INTERROGADOR* y el *ESPÍA* disponen para la sonora de sendos altavoces por los que se podrá emitir una señal de alerta en el caso de surgir desviaciones significativas del itinerario además, cuantos mensajes se estimen necesarios. Para la visual tendrán, respectivamente, pilotos de señalización de incidencias y ventanillas o portales digitales divididos en dos secciones; una con fondo de un determinado color (por ejemplo, amarillo), otra con fondo en otro color (por ejemplo, rojo) y ambas con dígitos en negro. En ellas podrán leerse los mensajes que interese para el permanente control del equipaje, la mercancía o el vehículo.

5ª) Sistema de registro electrónico de equipajes, mercancías y vehículos (según reivindicación 1ª) caracterizado porque el *cuerpo fijo* o *INTERFACE* dispone también de un piloto luminoso que permitirá distinguir las distintas fases del proceso de carga o transferencia de datos y las diversas incidencias que pudieran acaecer.

6ª) Sistema de registro electrónico de equipajes, mercancías y vehículos (según reivindicación 3ª) caracterizado porque el *INTERFACE* dispone de un mecanismo para facilitar la expulsión de los elementos del cuerpo móvil.

7ª) Sistema de registro electrónico de equipajes, mercancías y vehículos (según reivindicación 1ª) caracterizado porque los carros o vehículos de recogida de los equipajes y las mercancías, al final de cada cinta transportadora o de cada terminal o muelle de carga así como los transportes o almacenes de vehículos mantendrán como señuelo un dispositivo con parte de la información grabada en la memoria de las componentes del *cuerpo móvil* para evitar que se disparen las alarmas del *INTERROGADOR* y del *ESPÍA*.

8ª) Sistema de registro electrónico de equipajes, mercancías y vehículos (según reivindicación 1ª) caracterizado porque la transmisión de datos entre sus distintos elementos se efectuará habitualmente, una vez separados éstos, mediante señales de frecuencia ciudadana sin perjuicio de trabajar con otras cuando así lo requieran las características del transporte, las circunstancias específicas de cada itinerario o el medio en que se realice éste.

GRÁFICOS

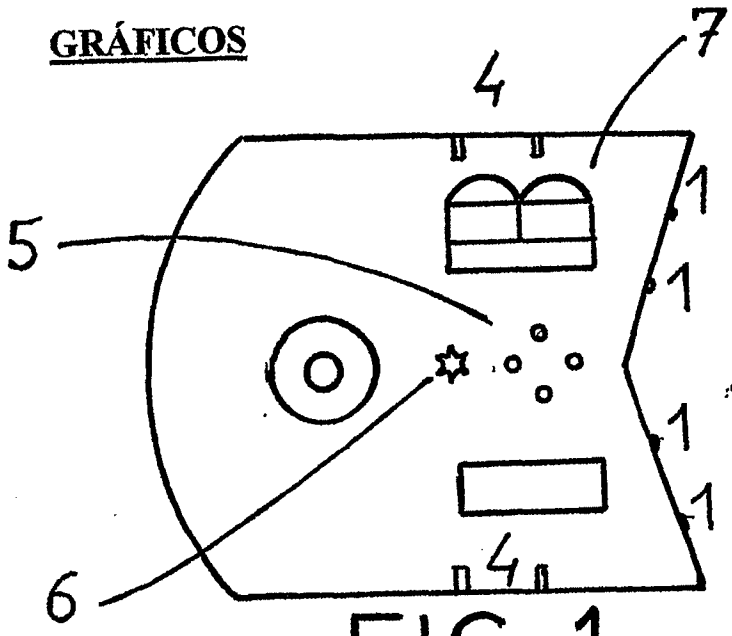


FIG. 1

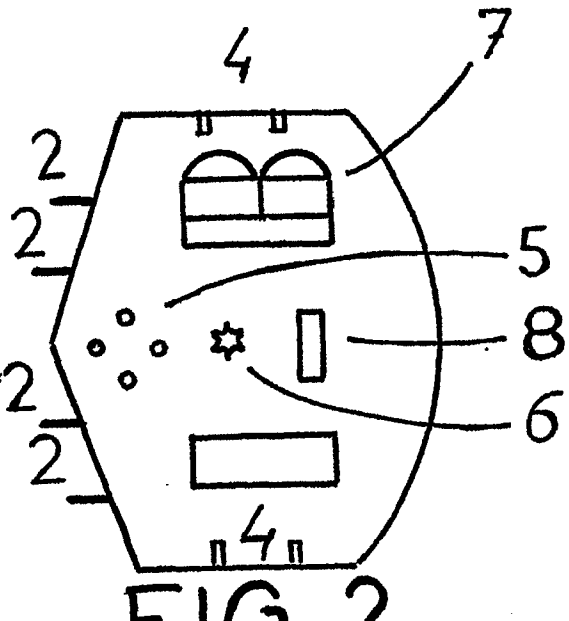
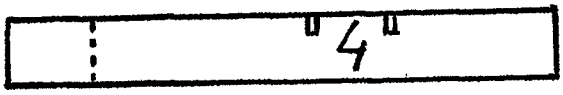
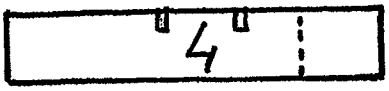


FIG. 2





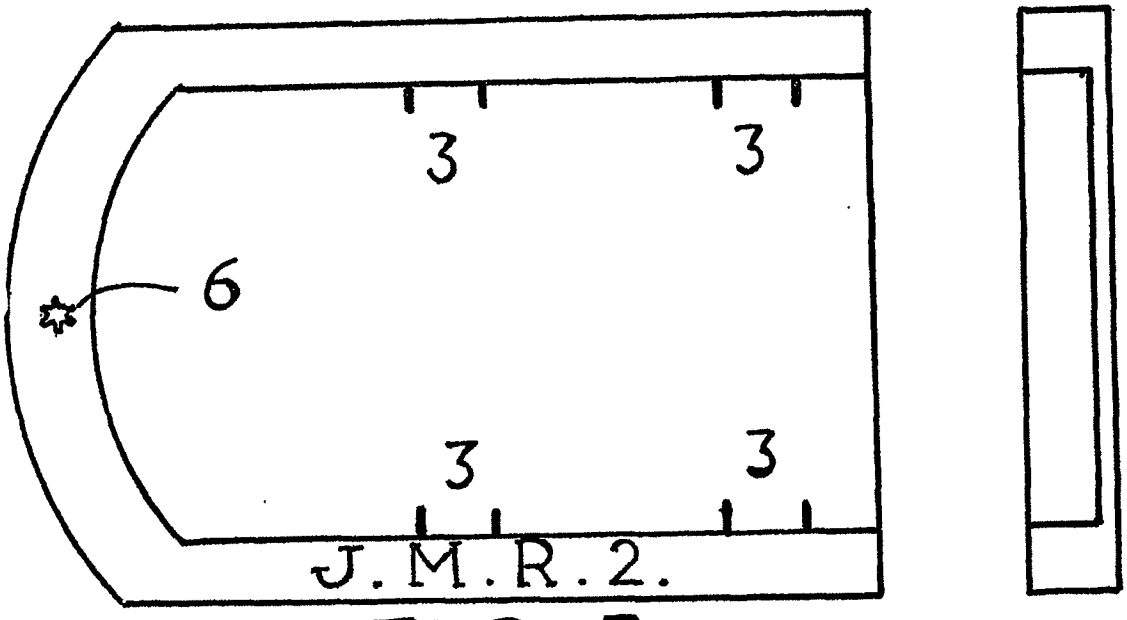


FIG. 3

INTERNATIONAL SEARCH REPORT

International application No.
PCT/ ES 02/00160

A. CLASSIFICATION OF SUBJECT MATTER

IPC 7 **G08B 13/24, G06K 19/07**

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 7 G08B, G06K

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

WPI, EPODOC, PAJ.

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	EP 712102 A1 (RAIMBAULT, P. et al.) 15.05.1996, **page 3, line 39 - page 4, line 55; figures**	1,7,8
A	US 5751246 A1 (HERTEL, R.J.) 12.05.1998, **column 4, line 9 - column 5, line 22; column 7, lines 8-26; column 8, lines 12-27; figure 3.**	1,4,7,8
A	WO 0072251 A1 (LOUREIRO BENIMELI, F. J.) 30.11.2000, **page 12, line 22 - page 13, line 32; page 16, line 1 - page 17, line 9; page 22, line 21 - page 23, line 1; page 26, line 7 - page 28, line 4; figures 6-8**	1,8
A	DE 3604307 A1 (BROWN, BOVERI UND CIE.) 13.08.1987	
A	EP 940763 A1 (LUCENT TECHNOLOGIES) 08.09.1999	

☐ Further documents are listed in the continuation of Box C. ☒ See patent family annex.

* Special categories of cited documents:

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"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
28 June 2002 (28.06.02)	**05 July 2002 (05.07.02)**
Name and mailing address of the ISA/ **S.P.T.O.**	Authorized officer

INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No

PCT/ ES 02/00160

Patent document cited in search report	Publication date	Patent familiy member(s)	Publication date
EP 712102 A1	15.05.1996	FR 2726659 A1 EP 712102 B1 DE 69524926 E	10.05.1996 09.01.2002 14.02.2002
US 5751246 A1	12.05.1998	NONE	
WO 0072251 A1	30.11.2000	EP 1164540 A1	19.12.2001
DE 3604307 A1	13.08.1987	DE 3604307 C2	06.04.1995
EP 940763 A1	08.09.1999	NONE	

INFORME DE BUSQUEDA INTERNACIONAL

Solicitud internacional nº
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A. CLASIFICACIÓN DEL OBJETO DE LA SOLICITUD
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B. SECTORES COMPRENDIDOS POR LA BÚSQUEDA

Documentación mínima consultada (sistema de clasificación, seguido de los símbolos de clasificación)
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Otra documentación consultada, además de la documentación mínima, en la medida en que tales documentos formen parte de los sectores comprendidos por la búsqueda:

Bases de datos electrónicas consultadas durante la búsqueda internacional (nombre de la base de datos y, si es posible, términos de búsqueda utilizados):
WPI, EPODOC, PAJ.

C. DOCUMENTOS CONSIDERADOS RELEVANTES

Categoría*	Documentos citados, con indicación, si procede, de las partes relevantes	Relevante para las reivindicaciones nº
A	EP 712102 A1 (RAIMBAULT, P. et al.) 15.05.1996, página 3, línea 39 - página 4, línea 55; figuras.	1,7,8
A	US 5751246 A1 (HERTEL, R.J.) 12.05.1998, columna 4, línea 9 - columna 5, línea 22; columna 7, líneas 8-26; columna 8, líneas 12-27; figura 3.	1,4,7,8
A	WO 0072251 A1 (LOUREIRO BENIMELI, F. J.) 30.11.2000, página 12, línea 22 - página 13, línea 32; página 16, línea 1 - página 17, línea 9; página 22, línea 21 - página 23, línea 1; página 26, línea 7 - página 28, línea 4; figuras 6-8.	1,8
A	DE 3604307 A1 (BROWN, BOVERI UND CIE.) 13.08.1987	
A	EP 940763 A1 (LUCENT TECHNOLOGIES) 08.09.1999	

☐ En la continuación del recuadro C se relacionan otros documentos ☒ Los documentos de familia de patentes se indican en el anexo

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Información relativa a miembros de familias de patentes

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Documento de patente citado en el informe de búsqueda	Fecha de publicación	Miembro(s) de la familia de patentes	Fecha de publicación
EP 712102 A1	15.05.1996	FR 2726659 A1 EP 712102 B1 DE 69524926 E	10.05.1996 09.01.2002 14.02.2002
US 5751246 A1	12.05.1998	NINGUNO	
WO 0072251 A1	30.11.2000	EP 1164540 A1	19.12.2001
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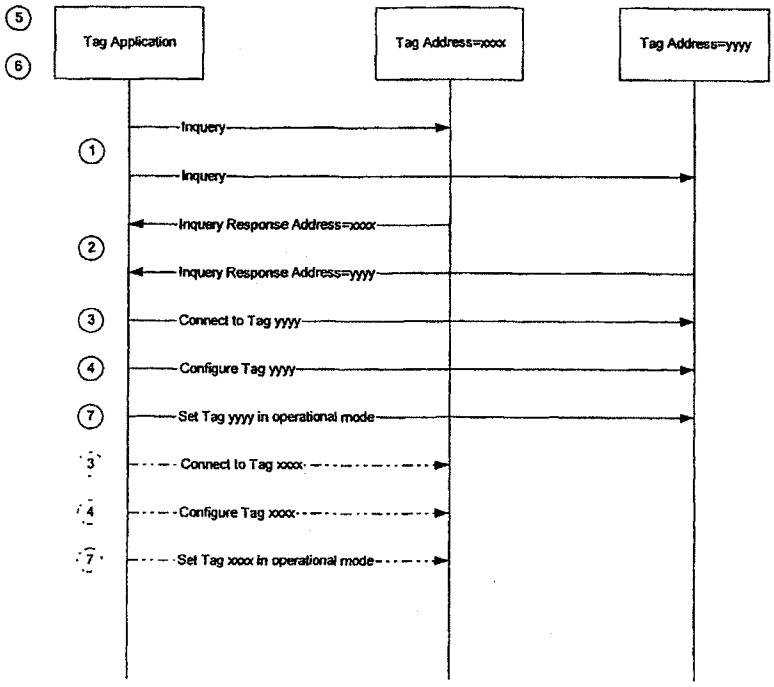
(54) Title: AN OBJECT DETECTION SYSTEM



(57) Abstract: The present invention relates to a system and a method for detecting and identifying an object. More specifically the invention relates to a tag for attachment e.g. to luggage, the tag being adapted for transmission of an identifiable signal and a receiver for detecting and identifying the signal. The invention is concerned with use of the Internet and handheld terminals such as

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AN OBJECT DETECTION SYSTEM

Field of the Invention

The present invention relates to a system and a method for detecting and identifying an object. More specifically the invention relates to a tag for attachment e.g. to luggage, the tag being adapted for transmission of an identifiable signal and a receiver for detecting and identifying the signal.

The present invention is concerned with the use of Bluetooth™ technology for detection of the object.

Description of the Prior Art

In general, the detection and identification of objects relates to the problem of finding an object or to the problem of detecting the loss of an object. The object could be anything such as luggage, a car, a bicycle or even persons. The problem of finding the object could be the problem of finding a specific car in a car park or city, finding luggage on a luggage conveyer in an airport, finding a specific bike in a school yard or of finding a person such as a child in a school yard or in a shopping centre etc. The problem of detecting the loss of an object could be detecting whether the object is being stolen or whether the object has been forgotten.

Generally speaking, methods and devices for the identification and detection of objects exist. As an example luggage is typically labelled with a hand written or a bar coded label indicating the identity of the owner of the luggage. However, the hand written label can be impossible to read either due to a bad handwriting or the label may be destroyed by humidity or by the transportation of the luggage. The hand written label does not in it self constitute a guarantee for the identity of the owner of the luggage, since it is easy to change the label or to write a label with a wrong name or address. Moreover the label does not alert the owner if the luggage is either forgotten or stolen. Air cargo and airport staff in general experiences huge problems on luggage handling. As an example, it can be difficult to find owners of luggage that has been left or forgotten and it can be difficult to trace the place of sojourn of the traveller. A badly written luggage tag can cause that the

luggage ends up in a wrong destination. For that reason, insurance companies as well as airline companies effect expenditures for compensation of lost luggage.

Similarly systems for identification of persons exist. As an example people are typically identified towards authorities e.g. in relation to inspection of tickets, for admittance control etc. In general the existing systems are related with the same mentioned drawbacks as the systems for luggage detection.

Description of the Invention

It is an object of the present invention to provide a tag that can be attached to objects such as luggage or persons and that reduces or eliminates the above mentioned problems.

According to the object, the present invention relates to a system for detecting objects, said system comprising:

- at least one first transmitting unit to be located near the luggage, the first unit having an identity and being provided with a transmitter for transmitting a first signal representing the identity of the first transmitting unit, and
- a receiving unit provided with a receiver for receiving the first signal, the receiving unit being adapted to generate a second signal in case the first signal represents the identity of one of said at least one first transmitting unit(s),

the receiving unit being adapted to receive the first signal when the distance between the first transmitting unit and the receiving unit is within a predetermined interval.

The objects may be luggage, e.g. to be handled through a number of destinations, e.g. through an airport. The objects may also be persons, e.g. children in a kinder garden or in a school, prisoners in a jailhouse. It could also be a car, or it may simply be a system for the identification of persons, e.g. to be used in connection with ticket inspection in a fun park or in a public transportation system or for verification of identity in connection with admittance control systems. As an example, the first transmitting unit may be used in connection with admittance control, e.g. in a skiing resort. The identification of the holder of the tag could be used for later payment.

In general the objects may be any people or item for whom or which a reliable detection and/or identification is requested. The transmitting unit could be integrated in a luggage tag of if the object is a human being such as a child the transmitting unit may be integrated in a bracelet, a wristwatch or in clothes. The transmitting unit could also be integrated in sports equipment, in a bicycle, in a car or even in tools so that stolen tools can be found. As an example, the transmitting unit may be integrated in the frame of the bike, so that the bike can be found amongst a number of bikes, e.g. in a schoolyard. As another example, the transmitting unit may be integrated e.g. in ski bindings, thus enabling the ski equipment to be found amongst the ski equipment left outside a restaurant of left in the ski-room in a hotel or so that the skier may be identified when using the lift system - the transmitting unit thus acting as a ski-pass. By means of yet another example the transmitting unit may be integrated in a wristband so that the presence of the person wearing the wristband easily can be detected or found. The transmitting unit could also be integrated in key-rings etc. thus enabling the retrieval of a lost key.

Preferably the first transmitting unit comprises an active transmitting unit, provided with power driven means for transmitting the first signal in the form of a radio signal. The transmitting unit may be provided with a power source, e.g. in the form of a battery or in the form of solar cells or kinetic cells capable of charging an electrical current upon shaking, vibrating or in any other way moving the transmitting unit.

The receiving unit may be integrated in phone devices, computers, cars etc. or the receiving unit may be installed in a residential property so as to detect and identify objects or persons, e.g. for the purpose of admittance control.

The first transmitting unit could be an electronic circuit capable of transmitting a signal that can identify the circuit and thus identify a bag or a person or item carrying the tag. As an example the circuit could be integrated in a tag to be fastened e.g. to luggage.

By means of the second signal generated by the receiver, the owner of the luggage can be notified e.g. when the luggage arrives to the luggage claim area in an airport. The predetermined distance indicates towards the owner, how far away the luggage is when the second signal is received.

When the owner wants to check if the luggage is within close range, the receiver is turned on. If the receiver detects a signal the owner is notified, e.g. by the receiver transmitting a second signal in the form of a ringing, beeping, flashing, vibration etc. The receiver may even transmit a radio signal or an infrared signal to another electronic device, the signal indicating that the luggage is within the predetermined interval. As will later be described the reverse function, namely that the second signal is transmitted as the luggage is moved out of the predetermined distance could also be implemented. This function will help people to remember objects and alert in case of theft. As an example the function will help travellers to remember their luggage or alert in case the luggage is stolen. Both functions could be activated, so that whenever an object is detected, the receiving unit will automatically alert, if the object is taken out of the pre-specified area.

The system could interact with existing legacy systems. These systems could be airline barcode baggage systems, RFID systems or airline tracking systems or other systems that could ad valuable information to the technology like RFID or other short-range passive identification chips. By interacting with these existing systems and by allowing an owner of luggage with an identification unit - if it is of one of the older passive types or if it is a unit according to the present invention - to access the luggage handling system, it will be possible for the luggage owner to check an actual location of luggage during transit or flight. When a airline company realises, that a piece of luggage has been sent to a wrong destination, they can send an SMS or an email to the luggage owner and thus arrange proper redirection of the luggage. The address of the owner could be stored within the tag or stored at a Internet side addressed by the information stored in the tag.

As another example, a transmitting unit attached to a bike or similar object will alert the owner of the object if the object is stolen.

Preferably the first transmitting unit comprises an electronic data processing unit and may further have a storage unit for storing electronic data. The storage unit can be used for storing information related to the owner of the luggage. As an example the storage may be used for storing the name and address of the owner, a link to a home page of the owner, the blood type of the owner, the travel plan or schedule related to the luggage etc. The storage may also be used for storing information related to the luggage such as the weight of the luggage, the destination and origination of the luggage or safety instructions related to the handling of the luggage. As an example the information could be related to

a toxic, explosive, flammable or in any other way harmful content of the luggage and by means of the information stored in the storage, the persons handling the luggage may obtain useful information on how to handle the luggage safely. The information could also relate to the people who have been handling the luggage. As an example all people who have been handling the luggage may leave an insignia identifying them towards the owner of the luggage. When the owner of the luggage, after a journey gets the luggage delivered in the baggage claim area, it can easily be checked who, where and how the luggage has been treated. For that purpose the first unit may even be provided with input from an alarm device or from sensing devices capable of registering the conditions that the luggage has been subjected to, e.g. temperature, humidity, bumps etc or how many times the luggage has been opened.

The tag or information stored in the tag could preferably be associated with a database, e.g. a database which is accessible from the Internet. In the database, the owner of a tag may register all kinds of information, e.g. travel plans. The information stored in the tag could then be limited to a link or an address of the database information so that all relevant information can be retrieved directly from the database. The use of the database enables the owner of a tag to store a large amount of date without the limitations of the storage capacity of a relatively small electronic circuit of the tag. The use of a database also opens a number of opportunities for sharing information. As an example the customer of a flight ticket can simply use the tag with a link to a homepage of a travel company wherein the detailed travel plan is stored or a person may simply refer to a home page wherein personal information is stored, e.g. information extracted from an electronic calendar such as outlook from Microsoft. As another example, the use of the Internet will enable very flexible ways of paying for services. The holder of the tag could be identified in connection with admittance control, e.g. when entering a train, a bus, a cinema, a ski-lift system, a discotheque or any other place with admittance control. Along with the identification, an address and/or an authorisation code of an Internet account may be forwarded to the controlling authority and money may then be transferred from the holders account.

The owner of a tag may also choose to download information to be stored directly in the tag. The information could as for example relate to a travel plan. As an example the owner may download travel plans and other information related to the travel directly from a device connected to the Internet. The information could be an electronic flight ticket - E-

ticket - and by downloading the E-ticket to the tag, the owner verifies towards the airport authorities and/or the airline staff the details of the travel. The suitcase with the tag could thus have the same identity as the traveller towards the authorities. By downloading information directly to the memory of the tag, the information may be retrieved without a connection to the Internet.

Preferably the first unit is adapted to receive an activation signal. When the activation signal is received the electronic data processing unit is adapted to activate transmission of said first signal in response to recognition of the activation signal. As an example the first unit is adapted to operate in an inactivated mode and in an activated mode. The unit may then switch between the modes upon detection of an activation signal of a recognisable type. The signal could be provided by means of a signal switch operationally connected to the first unit or may be provided by means of a signal transmitted by a second transmitting unit such as transmitted by the receiving unit.

The activation signal could comprise an insignia representing an identity of the second transmitting unit. As an example the receiving unit could transmit the activation signal and the signal could include a code only known to the first transmitting unit and to the receiving unit. When the first transmitting unit recognises the signal and the code, it starts to transmit. The activation signal could also include a unique identifier of the transmitting unit and the first transmitting unit could be adapted only to start transmission upon the detection of such a unique identifier. In that way it is easy for the owner of the luggage to detect whom has been activating the first transmission unit.

The activation signal could also include an insignia representing the identity of the first transmitting unit. This could be an advantage e.g. if a large number of luggage pieces is located in one room and only one of the respective first transmitting units are to be activated. The activation signal could include an identification number for a specific first transmitting unit, and the first transmitting units could be adapted only to be activated upon the detection of an activation signal including their own identification number.

According to a preferred embodiment of the invention the system further comprises an initialisation unit adapted to transmit an initialisation signal to the first transmitting unit. The initialisation signal could be stored in the memory means for storing electronic data. The initialisation signal could comprise data related to the owner of the luggage, as earlier

described, name, address, blood type, destination address etc. or related to the contents of the luggage, weight of the luggage etc. The initialisation signal could also comprise date related to an encryption method for encryption of the communication between the receiving unit and the first transmitting unit. As an example, the first transmitting unit may receive a key for the encryption of the data to be transmitted. The first transmitting unit may also be provided with an encryption key from the beginning. In that case the key for the encryption could be printed on a removable label attached to the surface of the first transmitting unit. When the owner of the luggage wants to use the system for the first time, the key for the encryption is read from the label and entered into the receiving unit thus becoming capable of receiving data transmitted by the first transmitting unit. Thereafter the label is removed from the first transmitting unit allowing only those having the key to receive data from that unit. The initialisation signal may also include a software program adapted for the communication between the first transmitting unit and the receiving unit. The initialisation unit may be integrated in the receiving unit or the initialisation unit may be a separate unit, e.g. owned by dealers of the system or owned by the service personnel checking the luggage in at the airport. As an example the first transmitting unit may upon check in of the luggage in an airport receive an identification code. The code could be encrypted by use of an encryption key so that only authorised personnel can decode the identification code and so that no one but authorised personnel can change the code. Upon the check in procedure other information may be downloaded to the first transmitting unit, e.g. the flight schedule, the weight of the luggage etc.

The first and/or the second signal transmitted by respectively the first transmitting unit and the receiving unit and/or the initialisation unit could preferably be transmitted as a radio signal with a frequency range being in the order of 2,4 GHz. A frequency of this range provides a good transmissibility and enables compatibility with tools following the so-called Bluetooth™ standard for communication. Other frequencies and protocols may also be used. As an example the tag could be adapted for the DECT standard of for the HOME-RF standard or for the IEEE 802.11standard. As an example, the tag may be provided with a switch for switching between the different standards or the tag may even be adapted to automatically switch to a standard frequency and protocol, based on which signal the tag receives. If the tag receives a signal from a HOME-RF unit, the tag will switch into HOME-RF mode and return a signal etc.

Preferably the first unit is adapted to operate in a first mode and a second mode, the power consumption of the first unit when operating in the first mode being lower than the power consumption of the first unit when operating in the second mode. The first mode could be a mode wherein the first unit is listening for any communication following the same communication protocol as the first unit, e.g. communication following the Bluetooth™ communication protocol. The mode is an energy saving mode, enabling extended operation time with a relatively small battery driving the first unit. The second mode is a data processing and transmission mode, wherein the first unit is processing received communication data send by use of the same communication protocol as the first unit is adapted for. In case the date is recognised, e.g. in case the data comprises a correct unique identifier or in case the date is encrypted with a key known to the first unit, the first unit starts to transmit a signal. This is more power consuming than just listening for communication within a specific communication protocol, but the second mode is only activated shortly. The signal may be send within a time period shorter than one second. During the time period the first unit scans a pre-specified frequency band and selects one band wherein the signal preferably should be send, e.g. due to the fact that the frequency band is less influenced by radio noise or due to the fact that no other devices at that moment uses that frequency band. The first unit thereafter transmits the signal within the frequency band.

According to a preferred embodiment of the invention the predetermined interval is 0,01-10000 meters, such as 10-90 meters, such as 20-80 meters or such as 1-10 meters.

The user could enter the predetermined interval or it could be coded into the processing unit or stored in the storage unit by the maker of the system. Preferably the receiving unit comprises data input means for user input of the predetermined interval, e.g. in the form of a numeric keyboard or by means of a dial.

The first and/or the second signal could preferably include a message. As an example the message could be related to the events planned for the luggage, the content of the luggage or related to the owner of the luggage. The message could also be a link to an Internet address wherein further information related to the luggage may be retrieved. The message could be encrypted so as to control whom receives the message. As an example the first transmitting unit may transmit a message containing the name of the owner of the luggage. Before transmitting the message, the unit is encrypted by the use of

an encryption and decryption key known only to the first transmitting unit and the receiving unit. The encryption key could be stored in the memory means. When the receiving unit receives the message, it is being decrypted and presented to the user.

The receiving unit could be adapted to generate a notification signal in response to the message. As an example the notification signal could be that the receiving unit, e.g. by means of a WAP protocol connects the user to an Internet or WAP page included in the message. Another example is that the receiving unit transmits an e-mail, makes a phone call or in any similar way establishes a communication channel for transmission of the message, part of the message or for transmission of a predetermined signal based on the contents of the message. As an example an airport may be provided with a number of receiving units receiving messages from transmitting units attached to luggage passing nearby the receiving unit. Upon receiving messages from the transmitting units, the receiving units forwards those messages to a control system capable of processing the messages, e.g. in order to detect identities of the owners, calculate statistics related to the luggage etc. Another example is that a receiving unit is adapted to detect eventual e-mail addresses in the messages received, and upon the detection to forward advertising messages to the addresses or to forward a notification relevant to the owner of the luggage.

The receiving unit may have a display adapted to represent data representative of the message, e.g. a screen where text strings and graphics may be presented. The receiving unit may have further notification signalling means for transmission of notification signals upon the receiving a predetermined message. The notification signal could be that the receiving unit starts shaking, flashing, beeping or ringing upon receiving a message indicating that luggage owned by a certain owner, luggage of a certain kind etc, is within the distance.

According to a preferred embodiment of the system the receiving unit is integrated in a cellular phone such as a WAP phone, or integrated in a similar hand held device for transmission and receiving signals and/or capable of displaying messages and/or capable of transmitting notification signals. Examples of such devices are palm pilots, portable PCs with wireless communication interfaces etc.

Preferably the signals are transmitted and received with a communication protocol corresponding to the protocol for Bluetooth™ wireless communication. Bluetooth™ wireless technology is a de facto standard, as well as a specification for small-form factor, low-cost, short-range radio links between mobile PCs, mobile phones and other portable devices. The signals may also be transmitted and received with a communication protocol corresponding to the DECT standard, HOME-RF, IEEE 802.11 or similar market leading communication protocols.

The first and the second signal may also be transmitted as an acoustic signal, e.g. in the range between 20 kHz and 50 kHz, such as 25 kHz. This frequency is so low that a person would not be able to hear the signal. The acoustic signal could be used, e.g. in areas where the radio signal may interfere with other radio signals. An example of such an area is an airport, wherein the planes communicate with the control tower and navigates by means of radio signals, in hospitals wherein the radio signals may interfere with life important equipment or in areas with much radio noise.

The first and the second signal may also be transmitted as an optic signal, e.g. as an infrared signal.

Preferably the signals, no matter if they are radio signals, acoustic signal or optic signals are transmitted as digital and modulated signals.

The shift from the operation in the first mode to operation in the second mode may according to a preferred embodiment be based upon detection of an optical effect. As an example, the first transmitting unit may shift upon detection of light, as the luggage is taken out of the luggage compartment of an aeroplane

The first unit may also be adapted to shift from the operation in the first mode to operation in the second mode upon detection of a mechanical effect. As an example the shift may occur upon detection of bumps as the luggage is handled, upon detection of sound or upon detection of movement of the luggage, e.g. by the use of a device capable of detecting changes in the orientation of the unit.

According to a preferred embodiment of the invention the receiving unit is comprised in a key ring or in the bow of a key. Likewise the first unit may be integrated in a suitcase, such as in the handle of the suitcase or correspondingly integrated in the luggage.

According to a further preferred embodiment of the invention the receiving unit is adapted to generate the second signal in case the distance between the first transmitting unit and the receiving unit changes from being inside the predetermined interval to being outside the predetermined interval. As an example the owner of the luggage may want to be alerted if the luggage is moved outside the distance entered into the receiving unit such as if the owner forgets the luggage in a shop, or in case the luggage is stolen.
The receiving unit may as an example be adapted to generate a third signal representing the distance between the first transmitting unit and the receiving unit. The third signal could be a tone amplified according to the distance between the first transmitting unit and the receiving unit. The third signal could also be a dial showing the distance either in relation to the pre-determined distance entered into the receiving unit or it could simply be a digital display indicating the distance, e.g. in a selectable measuring unit. Preferably the receiving unit is also adapted to generate a fourth signal representing a distance deviation between the first transmitting unit and the receiving unit indicating if the distance is increasing or if the distance is decreasing.

According to another aspect the present invention relates to a receiving unit for use as the receiving unit of the above-described system.

According to another aspect the present invention relates to a transmitting unit for use as the transmitting unit of the above-described system.

According to another aspect the present invention relates specifically for a system for detecting luggage.

According to yet another aspect the present invention relates to a method of detecting luggage, said method comprising the steps of:

- attaching a transmitting unit to the luggage, the unit having an identity and being provided with a transmitter for transmitting a signal representing the identity of the unit, and

- using a receiving unit provided with a receiver for receiving the first signal, and
- analysing the signal so as to determine the identity.

According to another aspect the present invention relates to a computer system for handling luggage, said computer system having processing means, receiving means for receiving a signal, input means for user provided input, output means for transmitting a signal and storage means having stored therein a computer program said processing means being adapted, in response to commands from said computer program, to:

- receive a signal from a transmitting unit,
- based on the received signal, to determine the identity of the transmitting unit, and
- to generate a signal in case the identity of the transmitting unit is identical to a reference identity.

The reference identity could be entered by the user, through the input means and the generated signal could be transmitted to the user via the output means, e.g. in the form of an acoustic signal.

According to another aspect the present invention relates to a computer program for an electronic processing system, the computer program being adapted to perform the above mentioned method.

Detailed description of the invention

A preferred embodiment of the invention will now be described in details with reference to the drawing in which:

Fig. 1 is a block diagram showing a preferred embodiment of a transmitting and receiving unit according to the invention,

Fig. 2 shows the "configure tag function" of the system application,

Fig. 3 shows the "discover luggage tag in range" application,

Fig. 4 shows an embodiment of a transmitting unit attached to the handle of a suitcase,

Fig. 5 shows a receiving unit attached to a key ring,

Fig. 6 shows an alternative embodiment of the invention, wherein the receiving unit is provided in a portable terminal,

Fig. 7 shows an example of the use of a system according to the invention, adapted to localise a suitcase on a luggage transport system, e.g. in an airport terminal,

Fig. 8, Fig. 9 and Fig. 10 show three different ways of attaching the tag to luggage,

Fig. 11 shows the receiving unit integrated in a mobile phone device, and

Fig. 12, Fig. 13 and Fig. 14 show three different situations wherein the system may be used.

The following example relates to a system according to the present invention and adapted for detecting and identifying luggage. The system comprises a transmitting unit to be attached to the luggage and a receiving unit. In the following example the transmitting unit will thus be referred to as the luggage tag and the receiving unit will be referred to as luggage detector. The luggage detecting system is a set of at least one luggage tag and a luggage detector, which in the following example is a combined unit with an initialisation unit.

Referring to Fig. 1 the luggage tag and the luggage detector comprises four main components, a power control circuit 1 a Bluetooth™ radio module 2, an interface for add-on components 3 and a processor 4. The four main components are interconnected by means of a system bus 5. The unit further comprises an EEPROM and/or RAM circuit for storing data and an antenna for the transmission and/or receiving of radio signals. Additionally the unit may be provided with an amplifier for amplification of the radio signal, or for the amplification of other signals, such as acoustic signals. The unit is comprised in a case capable of protecting the components from mechanical impact, e.g. due to rough handling of luggage.

The power control circuit 1 could be a battery and additional components for support of the unit in a time period such as for one year. The batteries could be selected from a combined requirement for supporting the unit with power and for keeping the size of the unit low. Regular AAA batteries may be preferred.

The interface for add-on components is adapted for optional parts such as for a display, for a push-button, for a speaker for the transmission of an acoustic signal or for a vibrator for the transmission of a vibration signal etc.

The processor 4 in combination with the EEPROM and/or RAM circuit will be the hardware platform for a software application. Through the antenna, the software application will be downloaded to the EEPROM. For this transmission the Bluetooth™ protocol will be used. In this way it will be possible to update the application as it is being developed. The processor, the RAM and/or the EEPROM are further responsible for the upper layers of the Bluetooth™ protocol.

The application

The system application consist of 3 different types of functions which all work together in order to obtain the desired function namely to configure the luggage tag and to detect when a specific luggage tag is respectively moved into or out of a specified distance range between the luggage tag and the luggage detector. When referring to range this means the Bluetooth™ area covered by the system containing the system application or it means a range specified by the operator of the luggage detector or a range coded into the memory of the luggage tag.

The system application utilises the Bluetooth™ protocol in order to detect luggage tags in or out of range.

Initially when luggage tags are shipped they do not contain any user data and they are in an active discovery state, which means that they can be detected by an Inquiry from the system application.

Configuration of the luggage tags

At first when a new luggage tag is to be used the configure tag function of the system application is used. The "configure tag function" of the system application is shown in Fig. 2 and works as follows:

1. The system application sends an Inquiry command to any Bluetooth™ device within the specified range. This Inquiry command is repeated several times and acts as a broadcast command meaning that any Bluetooth™ device in range and which is in an active discovery state will respond.

2. The Bluetooth™ device named xxxx and the Bluetooth™ device named yyyy respond with their Bluetooth™ address.

3. The system application operator (the one operating the luggage detector) selects the device that he/she wishes to configure and connects to the device.

4. The operator enters all the details such as name, address, zip-code etc. and optionally sets a unique pin code which will be used for authentication and/or for encryption of the transmitted data.

5. The system application stores the address of the luggage tag, e.g. in the device named xxxx and the associated data and pin code.

6. Optionally the system application will send the address of the luggage tag and the associated user data (but not the pin code) to an Internet Server which keeps all the information in a common database (all registered luggage tags).

7. The system application sets the luggage tag in normal operational mode, which is active discovery state.

The user is free to reconfigure the luggage tag (the device named xxxx) or the user is free to go on to the configuration of any additional luggage tags. If a pin code was specified in the configuration of a device this same pin code is required in order to reconfigure that device. Only a reset (loss of power) can reset the Tag to initial state. This may require either that the battery is removed from the device or that a reset button is pressed.

Discover a luggage tag positioned within range of the luggage detector

In order to discover luggage tags coming into the range of a system application the luggage tag(s) will have to be in an active discovery state. The active discovery state is the normal operation of the luggage tag(s).

In Fig. 3 shows the "discover luggage tag in range" application and it works as follows:

1. The operator of the luggage detector activates the "discover luggage tag(s) in range" function which will start sending an inquiry in order to obtain Bluetooth™ device addresses within the specified range.

2. Any Bluetooth™ device within the range and in active discovery state will respond to the inquiry command with it's Bluetooth™ address. In this case the luggage tag named xxxx is in range and will respond.

3. The system application will check to see if any of the addresses received are configured in the application. If there is a match between the Bluetooth™ address and one of the configured addresses, then the system application alerts the operator by displaying the name of the luggage tag and optionally transmits an acoustic alarm. The operator can then either exit the system application or alternatively set the system application in reverse mode. The reverse mode is adapted for detection of a luggage tag being within the range and going out of range.

4. The system application continues periodically sending out an inquiry in order to either discover whether the luggage tag named xxxx is going out of range or whether any other configured luggage tags are coming into range.

5. The luggage tag named xxxx responds to the inquiry with its address and confirms that the luggage tag is still in range. Eventually when the luggage tag named xxxx gets out of range the operator is alerted with a message or optionally with the acoustic alarm.

6. A luggage tag named yyyy gets into range and responds to the inquiry of the luggage detector. The system application will look up the Bluetooth™ address in order to see whether this address is configured as one of the operators configured Tags. The operator is alerted and can once again choose which action to take. The operator either exit the application or the operator sets the application in reverse mode in order to discover if the luggage tag named yyyy is going out of range.

7. The operator disables the system application. The luggage tags are still in operational mode.

The Bluetooth™ radio module can be purchased e.g. from cambridge silicon radio. A description of BlueCore™ 01 Single Chip Bluetooth™ System can be found on the Internet address www.CambridgeSiliconRadio.com. The Bluetooth™ protocol architecture can be found on the Internet address www.bluetooth.com.

Fig. 4 shows an embodiment of the luggage tag where the luggage tag is integrated in the handle 6 of a suitcase. The handle has a build-in Bluetooth™ circuit 7 connected to a power source 8 and an antenna 9. In order to improve the transmission from the antenna 9 the handle may be provided with a perforated area 10. The perforation also enables the Bluetooth™ circuit to be activated by means of light, e.g. when the suitcase is removed from an aeroplane.

Fig. 5 shows an embodiment of the luggage detector attached to a key ring 12. The luggage detector 11 has a switch 13 for switching the detector on and off. The luggage detector has a Bluetooth™ circuit 14 for transmitting and receiving signals between other Bluetooth™ circuits (luggage tags). The Bluetooth™ circuit is connected to a power source 15 and to an antenna 16. The speaker 17 is connected to the circuit and adapted for transmission of an acoustic signal upon detection of a luggage tag. The luggage detector may further be provided with a flash or a vibrator for the signalling.

Fig. 6 shows an alternative embodiment of the luggage detector wherein the luggage detector is integrated in a hand held terminal 18 with a screen 19. The screen is adapted for display of messages received from other Bluetooth™ circuits and for displaying graphics, e.g. pictures included in the message received from a luggage tag. The picture

could, as seen in Fig. 6 be a picture of the suitcase of the luggage tag, so that the operator of the luggage detector knows what to look for. The terminal has a switch button 20 for switching on and off and for regulating the volume of the acoustic signal. The keyboard 21 is provided for entering data to be transmitted to a luggage tag, and or for adjusting the distance range. The data to be transmitted to a luggage tag could be alphanumeric text strings, integers etc. As an example the operator may create a text string with a name and address. The text may be seen on the screen and may be edited by means of the keyboard and then transmitted to the luggage tag. The Bluetooth™ circuit 22 and the antenna 23 is adapted for transmission of Bluetooth™ signals.

Fig. 7 shows a luggage conveyer 23 and three pieces of luggage 24,25 and 26. The suitcase 26 is provided with a handle 27 with an integrated luggage tag 28. The terminal 18 is similar to the terminal of Fig. 6. As the suitcase 26 is advanced on the conveyer the luggage tag is activated e.g. by the movement of the conveyer or by the illumination of the room or the luggage tag is activated by presence of Bluetooth™ signals in the area.

Fig. 8, Fig. 9 and Fig. 10 shows three different embodiments of the luggage tag. Fig. 8 shows a luggage tag similar to well known luggage tags for hand written labels but for electronic transmission of Bluetooth™ signals. The luggage tag can be attached to the luggage by means of the strap.

Fig. 9 shows a suitcase wherein the luggage tag is integrated in the case. This is a preferred embodiment of the luggage tag since it is very difficult to remove the luggage tag or to switch luggage tags between suitcases. The airport staff may e.g. at the check in procedure download a unique and encrypted identification and destination code in the luggage tag. The luggage tag is integrated into the case in a security proved way and can only be removed from the luggage by visible destruction of the case. The tag may therefor throughout the journey be used for identification and routing of the suitcase.

Fig. 10 shows a suitcase with the luggage tag integrated in the handle of the suitcase.

Fig. 11 shows a cellular phone such as a WAP phone with an integrated luggage detector. The luggage detector may utilise the existing facilities of the phone, such as the power supply, the screen, the keyboard, the speaker and/or a vibrator. In certain cases the luggage detector may even use the existing transmitting frequencies and/or the antenna

of the cellular phone. The luggage detector could as an example be adapted to use the cellular phone for establishing either a phone call or an Internet connection (WAP connection) based on the detection of a certain luggage tag or based on a message included in a detected luggage tag.

Fig. 12 shows a situation where a person is waiting for luggage in the baggage claim area of an airport. By means of a luggage detector the person is alerted that the luggage is within a distance of 10 meters, since the person has adjusted the luggage detector for a distance range of 0-10 meters. By means of the luggage detector the person can be informed about data and conditions related to the luggage. As an example the person can get a picture of the luggage or be informed if other persons have communicated with the luggage tag, e.g. if the airport staff has either downloaded or uploaded information from the luggage tag.

In Fig. 13 the person has forgotten the luggage in a restaurant and is now being alerted by the luggage detector. The alert is activated as the distance between the luggage detector and the luggage tag exceeds 10 meters.

Fig. 14 shows a situation wherein security staff in an airport inspects a suitcase left on the luggage conveyer. By means of a "Main Luggage Detector" the staff may request information from any luggage tag. In the shown example the "Main Luggage Detector" has received the name, phone number, address and e-mail address of the owner of the luggage. The information could also have been related to the flight schedule of the owner or to the content of the luggage.

In the following a number of examples of applications for the system will be described by means of examples.

The Basic function of the invention is directed towards a tag attached to a suitcase or similar luggage. The tag is used for the notification of a luggage owner when luggage enters or leaves a specified area such as a 10 meters radius. In airports the owner avoids having to wait in a line in front of the luggage conveyer. Instead the owner is notified when the luggage arrives on the conveyer. The owner can also make sure that the luggage picked up at the conveyor is the right luggage since only one luggage tag or at least only selected luggage tags are capable of communicating with the receiver of the owner.

When the luggage has been picked up, the receiver and/or the tag may be switched into a reverse mode wherein the owner of the luggage is notified if the luggage (or at least the tag) is moved outside the specified area. The tag and the receiver thus works as an alarm either towards theft or towards that the owner forgets the luggage.

The tag may of course not only be attached to luggage but be attached to any kind of articles. In the following examples a more general use of the tag for various purpose will be given.

Except from the advantage of tag system for alerting, the system will enable the return of articles with a tag to the owner due to information stored in the tag. As an example the system will enable that authorities such as police officers or security staff in the airport may read the information stored in a tag of a suitcase left over and the information may lead to the owner.

When a tag is used for the first time, the user may enter a web site where a list of applicable receivers may be selected as the receiving unit of the system. As an example the user may select between Palm pilots, mobile phones, PC's, Camcorders or similar devices capable of communicating according to the Bluetooth™ standard. When the receiver has been selected the user may download a software application corresponding to the selected device and/or corresponding to the selected use of the tag. If the receiver is capable of receiving digital information directly from the Internet, the software will be downloaded directly to the receiver. In other cases the software will be downloaded e.g. to a PC and from the PC downloaded to the receiver by means of Bluetooth™ communication or by means of any other data carrier such as a computer disc, a tape or similar.

When the software has been downloaded the Internet connection may be interrupted. In order to initialise the receiver and/or the tag, the user registers a name, an address or similar insignia representing the identity or address of the user. If the receiver is a mobile phone the information may be entered by means of the numeric keyboard, if the receiver is a palm pilot or a PC the information may of course be entered directly by means of the keyboard. The tag is also given a unique insignia in form of a text string such as a name -

"my suitcase no.1" a number or similar insignia. The insignia is downloaded from the receiver to the tag by use of Bluetooth™ communication.

When the user wants to use the system, the receiver is activated. If the user owns more than one tag, the user selects the tag or the tags that is going to be detected by the receiver and activates the detection mode. In case one or more of the tags enters a pre-specified range, the receiver transmits an attention signal and/or indicates on a display which tag is within the range. The user may now switch to reverse mode or the receiver may automatically switch to reverse mode. When that tag is moved outside the specified range the receiver once again transmits an attention signal. Even though the receiver is switched into reverse mode for one specific detected tag the receiver may be in regular mode for the other specified tags so that an attention signal is transmitted either if detected tags are moved outside the specified range or if undetected tags are being detected within the pre-specified range.

The communication between the receiver and the tags is protected so that only selected receivers may communicate with the tags. The receivers may be grouped so that one group of receivers is capable of communicating or at least capable of receiving information from any tag - a class 1 scanner, see description on the next pages. Those receivers could be sold exclusively to authorities. Another group of receivers may be capable of transmitting to any tag without being able to receive information from any tags. Those receivers could be sold to people who want to indicate that they have been handling e.g. luggage connected to the tag. Another group of receivers may be capable of transmitting information to all tags and capable of receiving information from selected tags. This would be the typical capability of a receiver owned by a regular user of the system.

As an example the tag system may be used for detecting the presence of a child. The tag could be provided integrated in a wristband, a waistband, in braces or reins or in barrettes. The system could be provided for notifying when the kids leave a pre-specified range from the receiver. As an example parents could use the system for surveillance of the kids while being on the beach, in a supermarket or just at home in the garden. The tag could be programmed with the name and address of the child, blood type and/or certain allergies such as allergy towards penicillin or anaesthesia so that a lost or even injured child may quickly be treated and brought back.

As another example the tag system may be used for professionals such as by contractors, craftsmen, plumbers etc. The tag could as an example be integrated in expensive tools so that theft can be detected. The tag may for example be programmed with a tool number and a description of the type of tool.

As another example the tag system may be used in connection with sports equipment. The tag may be integrated in skies, snowboards, golf bags, bicycles, canoes etc. and by means of the receiver the owner of the equipment can be notified if anyone steals the equipment. The receiver may also be used to ensure that the equipment is not mixed up with other people's equipment, which easily could be the case, e.g. outside a ski sports restaurant or outside the golf club.

As another example the tag system may be used for the surveillance of senior citizens, e.g. for surveillance of persons suffering from senile dementia. Again the tag could be programmed with information related to the persons health, address, contact persons etc.

As another example the tag system may be used for safety purposes. The tag could be integrated in safety vests or in off shore gear for persons working on ships, fishing boats, drilling platforms, shipyards or in similar environments. The tag could further be provided with visual signals such as a light that starts flashing when the tag gets outside the pre-determined area. The system could furthermore be integrated in other safety and/or navigational equipment such as integrated with a GPS system. In that case the GPS system could log the position at the moment the tag gets outside the pre-determined area. The tag could further be provided with GPS equipment so that the tag itself could transmit a signal including the position of the tag.

As another example the tag system could be used for identification and/or location of goods send via a mail system or via a shipping system. The tag could as an example be attached to a container for transportation of goods. The tag could be programmed with information relating to the good, such as relating to safety instructions for safe transportation of the goods or instructions for customs declaration of the goods. The tag could also be connected to equipment for surveillance of the conditions of the container such as the humidity or the temperature of the container. If e.g. the temperature gets outside a pre-determined area, the tag could send an attention signal to the receiver so

that the necessary pre-caution may be taken. The connected equipment could also store information related e.g. to the temperature in the tag, so that the conditions that the goods was subjected to, later can be monitored. The tag could also be used for checking the gods in and out between different transportation units. As an example the gods may be scanned by means of the tag system as it is loaded onto a truck and again when it is reloaded onto a ship and so on. In this way the system can support tracking the events of the goods and the position of the goods. The information programmed into the tag could be coded so that only the owner of the goods and authorities such as the customs or police may decode the information or eventually the shipping company may decode at least part of the information. As an example the information may be stored with different coding principles, e.g. so that the shipping company can read the shipping safety instructions, but not the actual content of the container. The customs on the other hand can decode the customs declaration but may not be able to se all details of the safety instruction, whereas the police may be able to decode al available information.

As another example the tag system may be used in connection with clothes. The tag could be integrated in cloth with the purpose of identifying the person wearing the cloth or with the purpose of theft protecting the cloth. The tag could be programmed with a code that identifies the person towards the authorities or that verifies the identity of the person in relation to admittance control etc.

At a hospital the tag may be used as an electronic identification of the patients and the information stored in the tag could relate to the actual medical record for a patient.

The tag could in general be used for connecting people or for alerting people of the presence of other people with certain characteristic properties which could be stored in the memory. As an example the tags could be used in bars, cafes or discotheques or even over the Internet via Internet-enabled mobile phones and PDAs for match-making. The people being present e.g. in a bar could all have a tag by means of which they can exhibit personal characteristics such as age, gender, interests etc. or they could even expose poems, a piece of music, a picture or the like. Each tag could be provided with a personal identification code and a password and indication of main interests such as to find a friend, sport or the like. The information could be stored in the memory of the tag or in an Internet database, in which case the tag should carry an address of the information in the Internet database. As an example, scanners could be installed at the entrance to

bars, cafés, pubs and discotheques or at similar places. When a person enters the bar, his or her tag will be scanned and the information will be uploaded to the Internet. Visitors of the home-page, e.g. people whom have been provided with a login name and a password, can now see the profiles of the persons in a particular bar or café or discotheque. Based on the knowledge about the persons in various places the visitor may decide which places to visit.

If a person wants to make contact with a person having a particular interesting profile, an e-mail or an SMS-message (Small Message Service for mobile phones) may be transmitted to that person. Due to the unique identification code of the tags, this may be possible even without knowing the name of the person having the profile. The system could be provided with a table containing the relations between the unique identification codes and either an e-mail address, a phone number an SMS identification code or similar identification means that may be used for making contact with the person carrying the tag. It will thus be possible for people to move anonymously around between bars, by not wearing a tag, by switching the tag off or simply by providing a relation between the tag and an anonymous address where to be reached.

As another example the tag could be used in connection with delivery of mail. The tag could be positioned on or nearby a letterbox. The owner of the letterbox (or the owner of the tag) visits a home page dedicated for the delivery of mail. At the home page, the owner fills out a form, indicating which kind of mail the owner wants to receive. Certain mail groups may thus be cancelled, e.g. in the case the owner does not want advertising folders or in the case the owner only wants advertising folders of a certain kind. The advertising folders could be divided into groups of interest e.g. in relation to food, hobby, leisure etc. In the form, the owner also indicates a unique insignia of the tag and optionally the name and address of the mail receiver of the letterbox. The owner could also indicate holidays or similar periods wherein the owner doesn't want any mail at all. In the future customers may sign a very flexible advertising on newspapers, e.g. paying for one paper a day. Everyday, e.g. before noon, the customer selects from a list on the home page, which paper to receive on the succeeding day. The publishers may use the home page to find out how many papers of each type to print and the paper man may use the tag connected to the letterbox together with a connection to the home page to find out which paper to deliver. The home page could also be used to check an account with the publisher or newspaper.

As earlier mentioned the receivers could preferably be grouped into class 1 receivers and class 2 receivers. Class 1 receivers could be provided to airport staff, railways station staff, lost property offices etc. The receiver is primarily adapted to receive and decode information with the purpose of receiving address information from the tags. Class 2 receivers could be provided to authorities, police, security staff, hospital staff etc, and be capable of receiving and decoding more sensitive or personal information from the tags. Finally of course a system user should be provided with a receiver capable of receiving all available information from those tags belonging to that user plus being capable of downloading information to those tags.

CLAIMS

1. An object detection system comprising:

- at least one first transmitting unit to be located near the object, the first unit having an identity and being provided with a transmitter for transmitting a first signal representing the identity of the first transmitting unit, and
- a receiving unit provided with a receiver for receiving the first signal, the receiving unit being adapted to generate a second signal in case the first signal represents the identity of one of said at least one first transmitting unit,

the receiving unit being adapted to receive the first signal when the distance between the first transmitting unit and the receiving unit is within a predetermined interval.

2. A system according to claim 1, wherein the first transmitting unit comprises an active transmitting unit, provided with power driven means for transmitting the first signal in the form of a radio signal and wherein the first transmitting unit comprises a power source.

3. A system according to claim 1 or 2, wherein the second signal comprises a signal selected from the group consisting of an acoustic signal, an optical signal, a motional signal, a radio signal, and an infrared signal.

4. A system according to any of claims 1-3, wherein the first unit comprises an electronic data processing unit, and wherein the first unit is adapted to receive an activation signal, the electronic data processing unit being adapted to activate transmission of said first signal in response to a recognition of the activation signal.

5. A system according to claim 4, wherein the activation signal is transmitted by a second transmitting unit

6. A system according to claim 4, wherein the activation signal is generated by a switch operationally connected to the first unit.

7. A system according to any of claims 4-6, wherein the activation signal comprises an insignia representing an identity of the second transmitting unit.

8. A system according to any of claims 4-7, wherein the activation signal comprises an insignia representing an identity of the first transmitting unit.

9. A system according to any of the preceding claims, further comprising an initialisation unit adapted to transmit an initialisation signal to the first transmitting unit, the first transmitting unit comprising memory means for storing data representative of the initialisation signal.

10. A system according to any of the preceding claims, wherein at least one of either

- the first signal,
- the second signal,
- the activation signal, and
- the initialisation signal

is transmitted as a radio signal with a frequency range, the frequency range being in the order of 2,4 GHz.

11. A system according to any of the preceding claims, wherein the first unit is adapted to operate in a first mode and a second mode, the power consumption of the first unit when operating in the first mode being lower than the power consumption of the first unit when operating in the second mode.

12. A system according to claim 10 and 11, wherein the first unit is adapted to shift from the operation in the first mode to operation in the second mode upon detection of a radio signal within the frequency range.

13. A system according to claim 11 or 12, wherein the first and/or the second unit is adapted to select a radio frequency band within said frequency range for the transmission of the first and second signal, the frequency band being selected from a number of predefined frequency bands.

14. A system according to any of the preceding claims, wherein the predetermined interval is 0,01-10000 meters, such as 10-90 meters, such as 20-80 meters or such as 1-10 meters.

15. A system according to any of the preceding claims, wherein the receiving unit comprises data input means for user input of the predetermined interval.

16. A system according to any of the preceding claims, wherein the first and/or the second signal contains a message.

17. A system according to claim 16, wherein the message is encrypted by the first transmitting unit, and wherein the receiving unit is adapted to decrypt the message.

18. A system according to claim 17, wherein the message is encrypted by means of an encryption key stored in the memory means.

19. A system according to claim 17, wherein the encryption key is part of the initialisation data.

20. A system according to any of claims 16-19, wherein the receiving unit is adapted to generate a notification signal in response to the message.

21. A system according to any of claims 16-19, wherein the receiving unit comprises a display adapted to represent data representative of the message.

22. A system according to any of claims 9-21, wherein the initialisation unit is integrated in the receiving unit.

23. A system according to any of the preceding claims, wherein the receiving unit is integrated in a cellular phone.

24. A system according to any of the preceding claims, wherein the receiving unit is integrated in a palm pilot.

25. A system according to any of the preceding claims, wherein the signal is transmitted with a communication protocol, and wherein the protocol corresponds to the protocol for Bluetooth™ communication.

26. A system according to any of the preceding claims, wherein the first and the second signal is transmitted as an acoustic signal.

27. A system according to claim 26, wherein the frequency of the acoustic signal is between 20 kHz and 50 kHz, such as 25 kHz.

28. A system according to any of the preceding claims, wherein the first and the second signal is transmitted as an optic signal.

29. A system according to claim 28, wherein the optic signal is an infrared signal.

30. A system according to any of the preceding claims, wherein the first and the second signal is transmitted as digital and modulated signals.

31. A system according to any of the preceding claims, wherein the first unit is adapted to shift from the operation in the first mode to operation in the second mode upon detection of an optical effect.

32. A system according to any of the preceding claims, wherein the first unit is adapted to shift from the operation in the first mode to operation in the second mode upon detection of a mechanical effect.

33. A system according to any of the preceding claims, wherein the receiving unit is comprised in a key ring.

34. A system according to any of the preceding claims, wherein the luggage is a suitcase and wherein the first unit is integrated in the suitcase.

35. A system according to any of the preceding claims, wherein the receiving unit is adapted to generate the second signal in case the distance between the first transmitting

unit and the receiving unit changes from being inside the predetermined interval to being outside the predetermined interval.

36. A system according to any of the preceding claims, wherein the receiving unit is adapted to generate a third signal representing the distance between the first transmitting unit and the receiving unit.

37. A system according to any of the preceding claims, wherein the receiving unit is adapted to generate a fourth signal representing a distance deviation between the first transmitting unit and the receiving unit.

38. A receiving unit for use as the receiving unit of the system according to any of the claims 1-36.

39. A transmitting unit for use as the transmitting unit of the system according to any of the claims 1-36.

40. A luggage detection system comprising:

- at least one transmitting unit to be located near the luggage, the unit having an identity and being provided with a power driven transmitter and a power source for transmitting a first signal representing the identity of the first transmitting unit, and
- a receiving unit provided with a receiver for receiving the first signal, the receiving unit being adapted to generate a second signal in case the first signal represents the identity of one of said at least one first transmitting unit,

the receiving unit being adapted to receive the first signal when the distance between the first transmitting unit and the receiving unit is within a predetermined interval.

41. A method of detecting luggage, said method comprising the steps of:

- attaching transmitting unit to the luggage, the unit having an identity and being provided with a power driven transmitter for transmitting a signal representing the identity of the unit and a power source, and
- using a receiving unit provided with a receiver for receiving the first signal, and

- analysing the signal so as to determine the identity.

42. A computer system for handling luggage, said computer system having processing means, input means for user provided input, output means and storage means having stored therein a computer program said processing means being adapted, in response to commands from said computer program, to:

- receive a signal from a transmitting unit,
- based on the received signal, to determine the identity of the transmitting unit, and
- to generate a signal in case the identity of the transmitting unit is identical to a reference identity.

43. A computer program for an electronic processing system, the computer program being adapted to perform the method of claim 40.

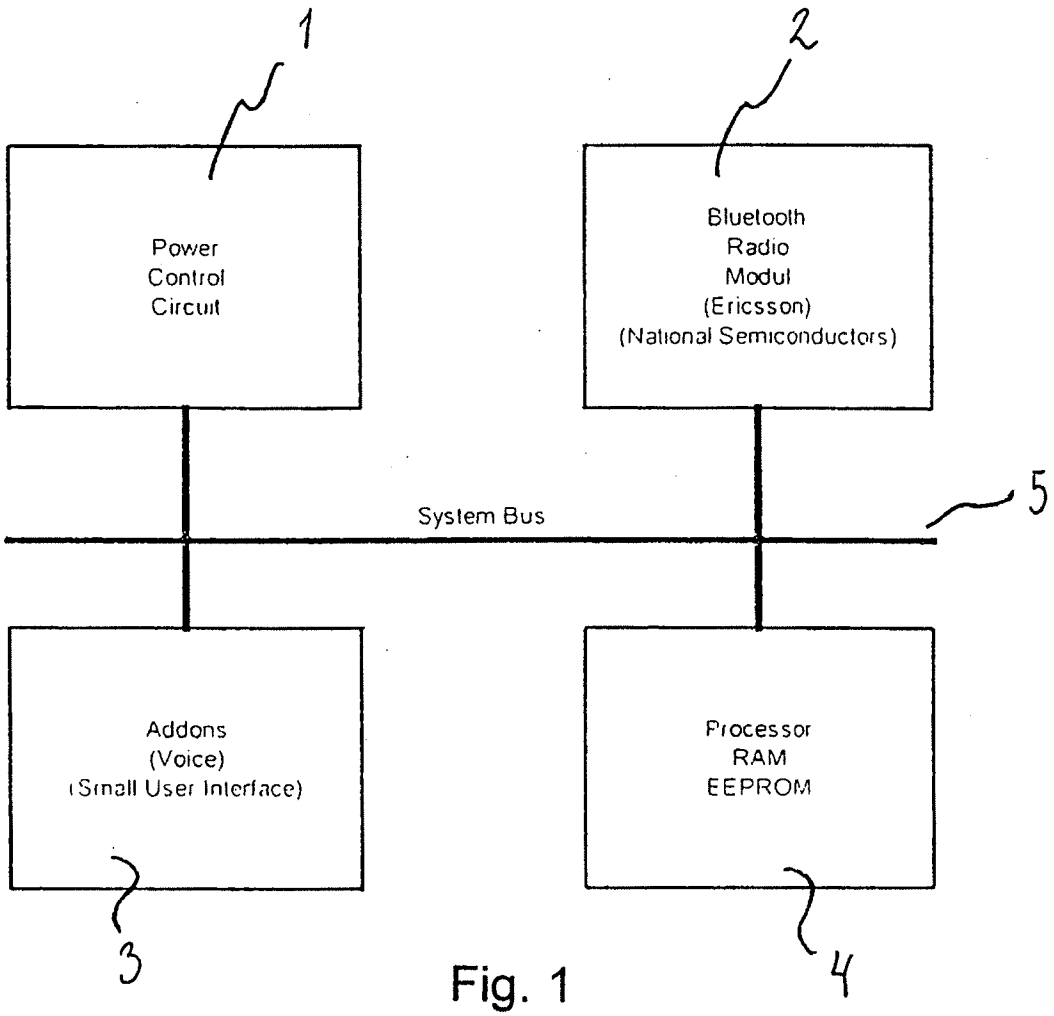
1
2
Power
Control
Circuit
Bluetooth
Radio
Modul
(Ericsson)
(National Semiconductors)
System Bus
5
Addons
(Voice)
(Small User Interface)
Processor
RAM
EEPROM
3
4

Fig. 1

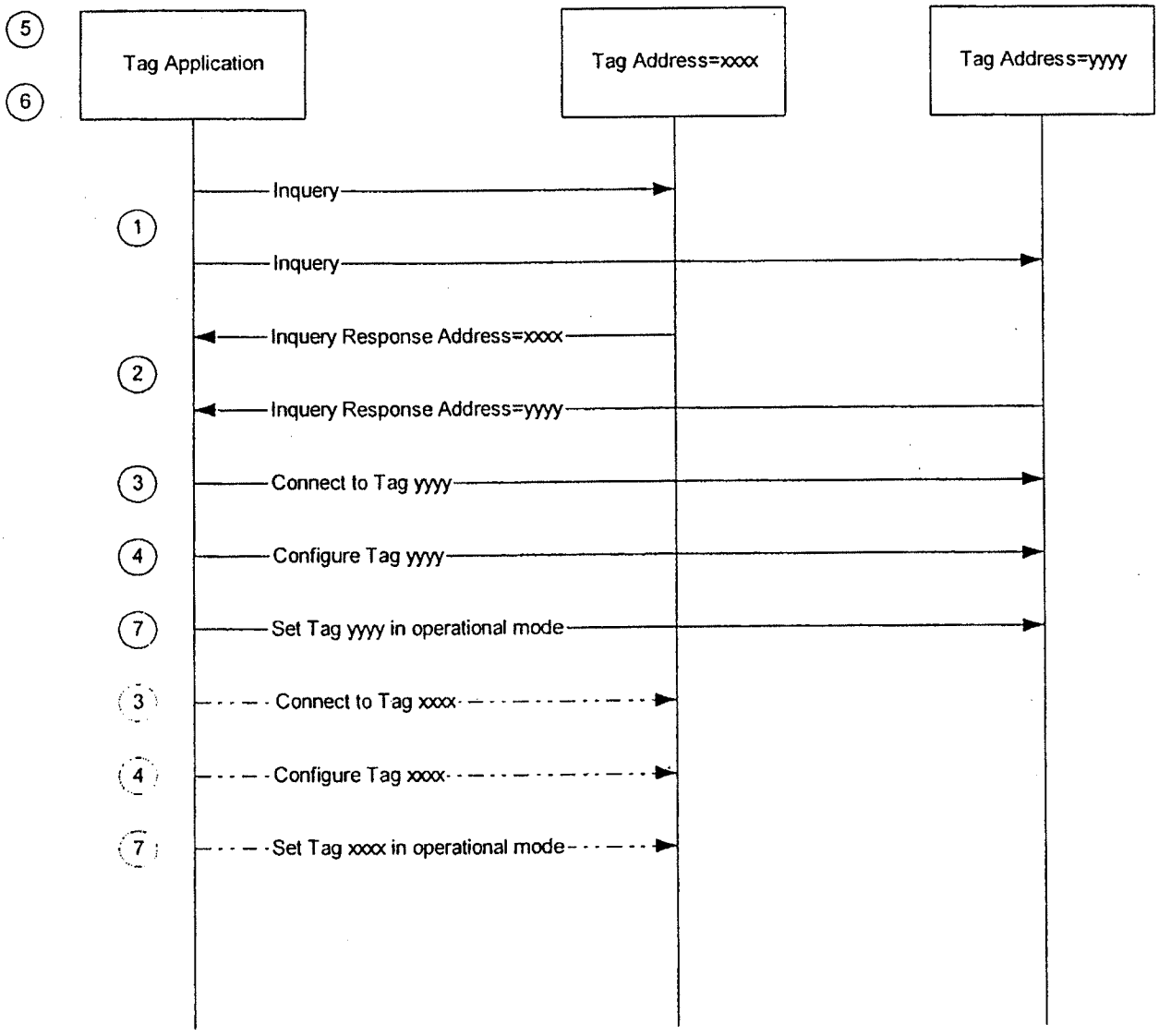
5
6
Tag Application
Tag Address=xxxx
Tag Address=yyyy
Inquery
1
Inquery
Inquery Response Address=xxxx
2
Inquery Response Address=yyyy
3
Connect to Tag yyyy
4
Configure Tag yyyy
7
Set Tag yyyy in operational mode
3
Connect to Tag xxxx
4
Configure Tag xxxx
7
Set Tag xxxx in operational mode

Fig. 2

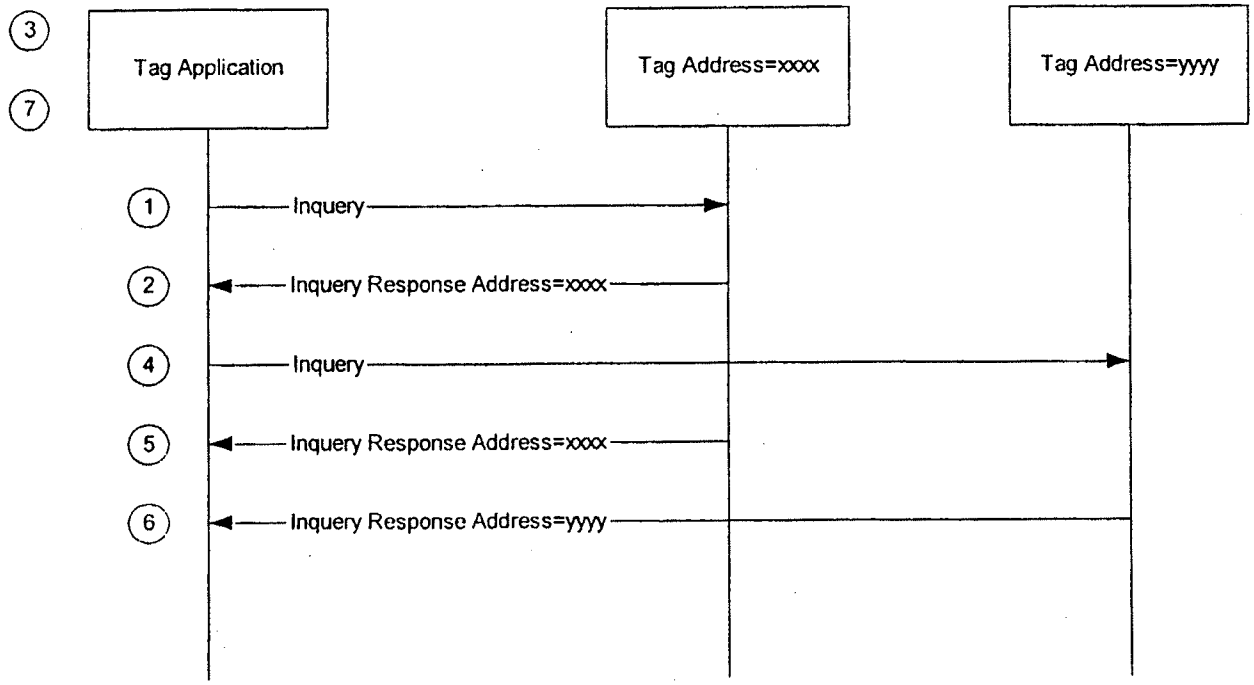
3
7
Tag Application
Tag Address=xxxx
Tag Address=yyyy
1
Inquery
2
Inquery Response Address=xxxx
4
Inquery
5
Inquery Response Address=xxxx
6
Inquery Response Address=yyyy

Fig. 3

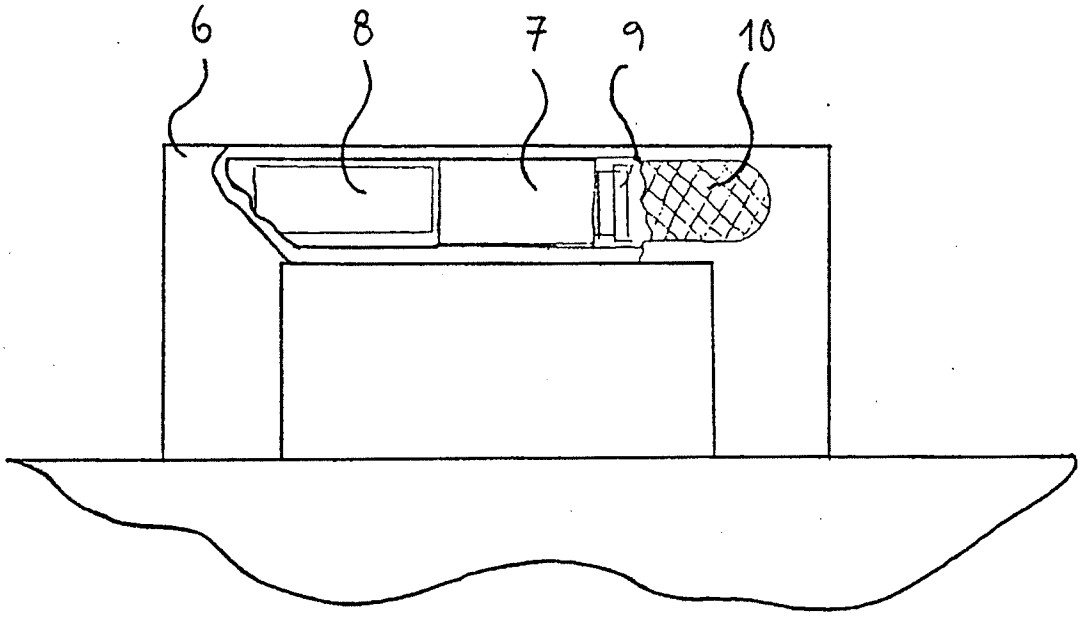

Fig. 4

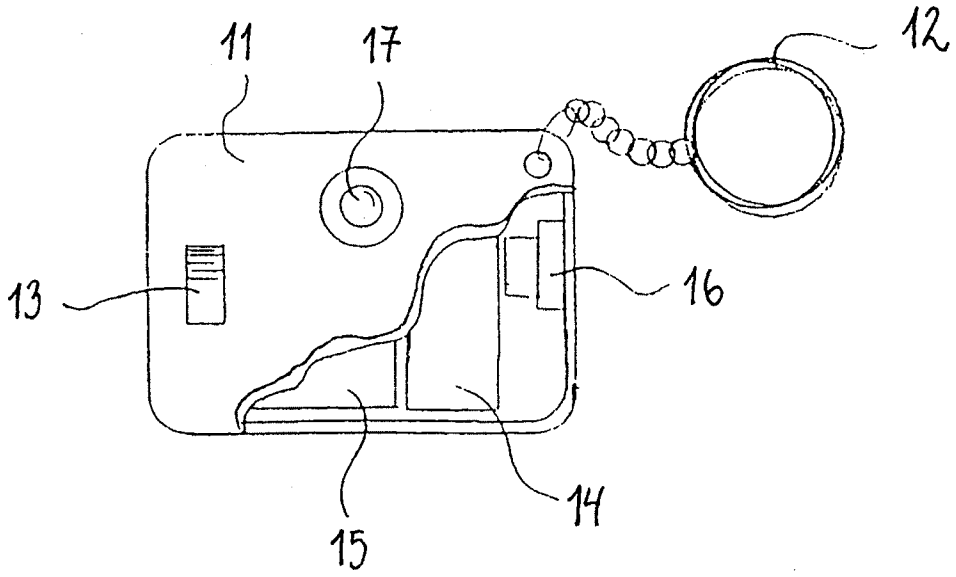

Fig. 5

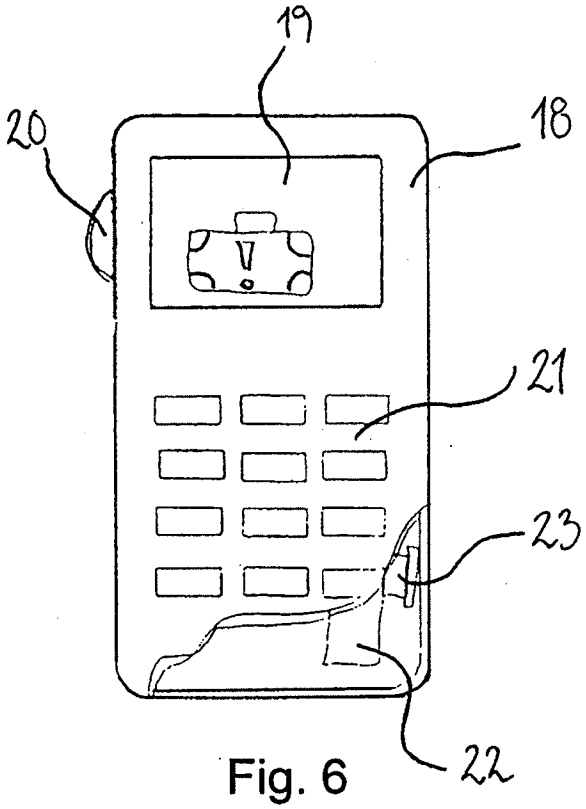

Fig. 6

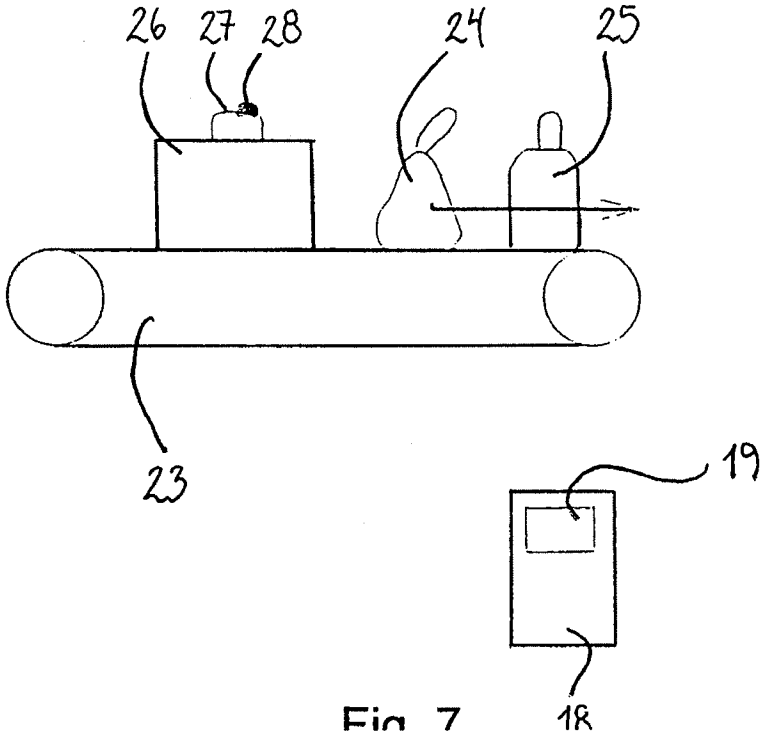

Fig. 7

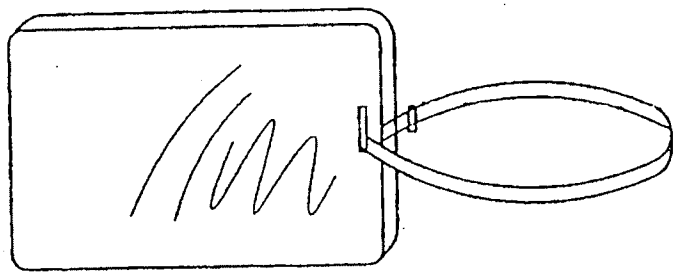

Fig. 8

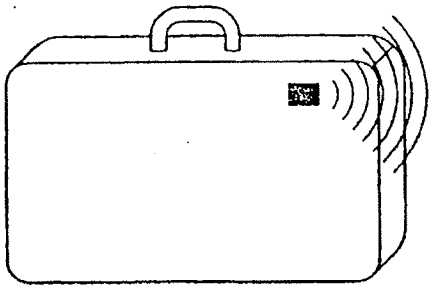

Fig. 9

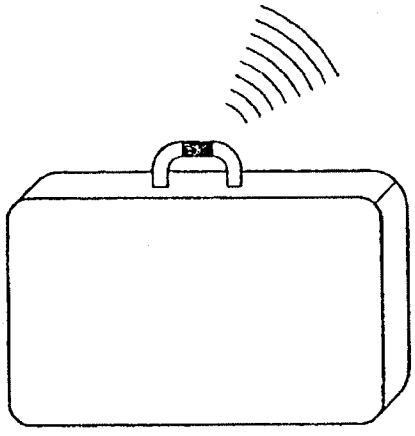

Fig. 10

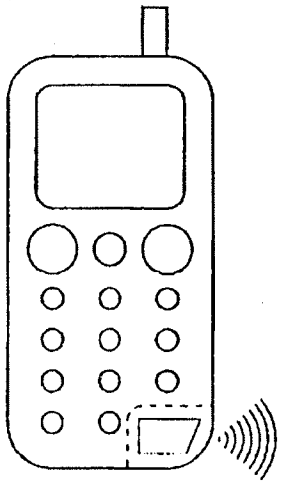

Fig. 11

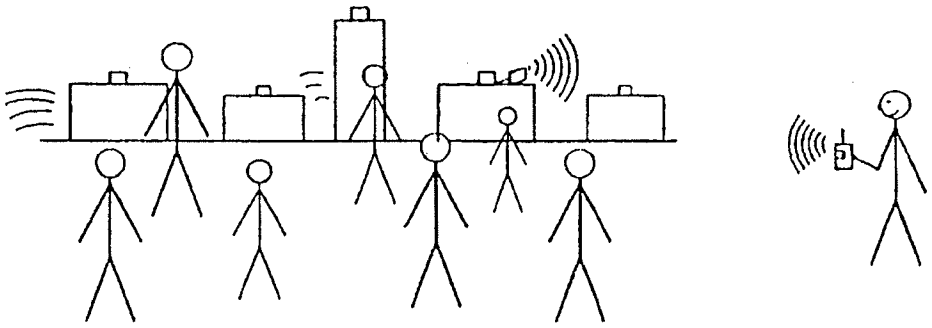

Fig. 12

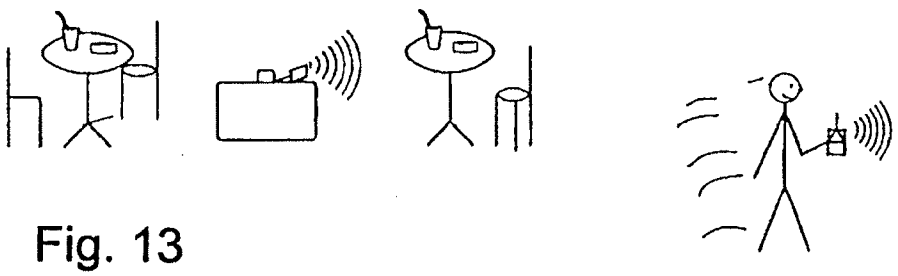

Fig. 13

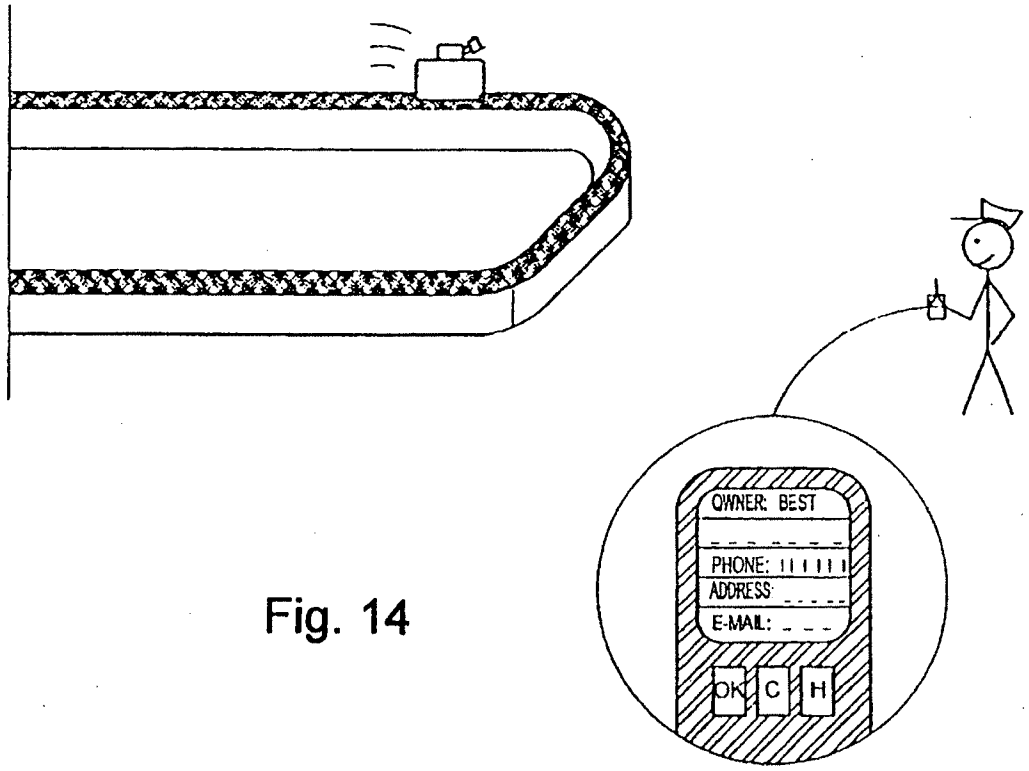

Fig. 14

INTERNATIONAL SEARCH REPORT

Inte onal Application No
PCT/DK 00/00637

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 G01V15/00

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 G01V

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

WPI Data, EPO-Internal, PAJ

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	GB 1 298 381 A (UNISEARCH LTD) 29 November 1972 (1972-11-29) page 1, line 21 - line 48 page 2, line 1 - line 79 page 5, line 61 - line 106 figure 1	1,2,4,5, 16,20, 34,35, 40-43
Y		3,6, 9-12,26, 28-32

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[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

° Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

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"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

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Date of the actual completion of the international search	Date of mailing of the international search report
13 February 2001	22/02/2001

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL – 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl,	

INTERNATIONAL SEARCH REPORT

Int onal Application No
PCT/DK 00/00637

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication,where appropriate, of the relevant passages	Relevant to claim No.
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INTERNATIONAL SEARCH REPORT

information on patent family members

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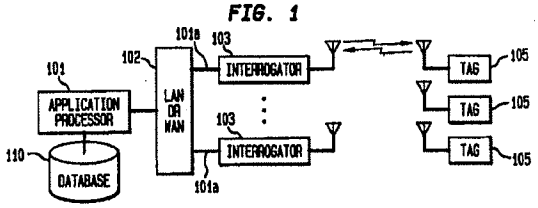
(54) Passenger, baggage, and cargo reconciliation system

(57) A radio frequency identification system, using modulated backscatter radio communications, is disclosed which supports the automated reconciliation of passengers, baggage, and cargo on a transport. A baggage tag (105) is attached to each piece of checked baggage, where the baggage tag is a read-only tag with modulated backscatter radio capability. Thus, each piece of checked baggage can be identified for sortation, and also identified to ascertain if it has been loaded onto a particular aircraft. Pieces of baggage can be either loaded directly onto an aircraft, or loaded onto a cargo container, where a cargo tag (105) is attached to the cargo container; the cargo tag is a read-write tag with modulated backscatter radio capability. The aircraft itself may be equipped with aircraft tags (105), which could be read-only or read-write tags with modulated backscatter radio capability. Aircraft tags allow a positive association between the identity of the baggage or cargo container being loaded, the aircraft on which it is being loaded, and the cargo bay doorway through which it is being loaded. To identify passengers, several alternatives are disclosed. In one embodiment, a magnetic boarding pass can be used with a magnetic stripe containing information about this passenger. In this embodiment, the passenger is responsible for inserting the magnetic boarding pass into a magnetic card reader as the passenger boards the flight. In another embodiment, a radio boarding pass could be used. The radio boarding pass resembles a conventional boarding pass, however it has read-only modulated backscatter radio capability, perhaps identical with the technology used for the baggage tag. The radio boarding pass can be read as the passenger boards the aircraft. In an alternate embodiment, the passenger can have a passenger card, which is a read-write tag with modulated backscatter capability. The passenger card can be read as the passenger boards the aircraft, to identify the passenger. Alternately, the passenger card can be used for a number of enhanced passenger service applications in a generalized transportation environment.

FIG. 1



EP 0 851 377 A1

Description

Related Applications

Related subject matter is disclosed in the following applications filed concurrently herewith and assigned to the same Assignee hereof: U.S. patent applications "Shielding Technology In Modulated Backscatter System," Serial No. _____; "Encryption for Modulated Backscatter Systems," Serial No. _____; "QPSK Modulated Backscatter System," Serial No. _____; "Modulated Backscatter Location System," Serial No. _____; "Antenna Array In An RFID System," Serial No. _____; "Subcarrier Fluency Division Multiplexing Of Modulated Backscatter Signals," Serial No. _____; "IQ Combiner Technology In Modulated Backscatter System," Serial No. _____; "In-Building Personal Pager And Identifier," Serial No. _____; "In-Building Modulated Backscatter System," Serial No. _____; and "Inexpensive Modulated Backscatter Reflector," Serial No. _____. Related subject matter is also disclosed in the following applications assigned to the same assignee hereof: U.S. patent application 08/504188, entitled "Modulated Backscatter Communications System Having An Extended Range"; U.S. Patent Application Serial No 08/492,173, entitled "Dual Mode Modulated Backscatter System,"; U.S. Patent Application Serial No. 08/492,174, entitled "Full Duplex Modulated Backscatter System,"; and U.S. Patent Application Serial No. 08/571,004, entitled "Enhanced Uplink Modulated Backscatter System." Related subject matter is also disclosed in the following U.S. Patents: U.S. Patent No. 4,711,994, U.S. Patent No. 5,051,565, and U.S. Patent No. 5,478,991.

Field of the Invention

This invention relates to wireless communication systems and, more particularly, to a wireless communication system using modulated backscatter technology.

Background of the Invention

In the transportation industry, four types of objects are typically transported; passengers, cargo, baggage associated with specific passengers, and cargo not associated with any passengers. To reconcile passengers, cargo, and/or baggage at the start and/or end of transport, it is important to know which passengers are "on board," which cargo and pieces of baggage are on board, and which cargo and pieces of baggage belong to which passengers, if any. Such reconciliation is performed using a passenger, baggage, and cargo reconciliation system. For illustrative purposes of this application, reconciliation systems will be described herein with reference to aircraft as the transportation mechanism.

Consider a commercial airline flight with passengers, baggage, and cargo on board the aircraft. The passengers board the passenger compartment of the aircraft and the baggage and cargo are stored in the cargo compartments of the aircraft. In larger or containerized aircraft, smaller pieces of baggage or cargo are stored in containers, which are then loaded onto the aircraft. Note that the term "container" includes, but is not limited to, containers and pallets. Smaller aircraft are typically "non-containerized" in the sense that the size of the cargo compartment is insufficient to accommodate the containers used in larger aircraft. Such aircraft are "freeloaded," i.e., each piece of baggage is manually loaded onto and removed from the aircraft. On a freeloaded aircraft, the pieces of baggage are typically transported up a moving ramp from the ground to the doorway of the cargo compartment. Note that some containerized aircraft may have portions of the cargo compartment that are insufficient to accommodate containers. In such containerized aircraft, a combination of freeloading and containerized loading techniques is used.

Let us consider some of the information the Reconciliation System should include for an aircraft. First, the Reconciliation System should include information regarding the identity of each passenger boarding the aircraft. Checking in for a flight does not guarantee that a passenger boards the aircraft. It is not uncommon for a passenger to arrive at the airport, check in at the gate and be given a boarding pass, and then fail to board the aircraft; such failure could be caused by the passenger being in the duty free shop, changing his/her mind about traveling, deciding to take a different flight, etc. Furthermore, the number of passengers on board and how those passengers are seated constitutes information used by the flight crew to plan a safe flight.

Second, the Reconciliation System should also include information regarding the baggage associated with the passengers. The passengers typically checked in their baggage at an airport curb or a check-in station. A baggage tag is usually attached to each piece of baggage, wherein a baggage tag is a paper with printed information, such as the name of the destination city and one or more flight numbers. More recently, a bar code having a "license plate" identification is also printed on the baggage tag, wherein the license plate includes a set of numbers and/or letters that identifies the originating airline and an index number that identifies the corresponding piece of baggage. The license plate is entered in a computer system and is typically associated with the passenger checking-in the baggage and his/her itinerary. The baggage is subsequently sorted and routed to the proper aircraft using the information contained in the baggage tag. Specifically, a baggage handler sorts and routes the baggage to an airport gate by reading the baggage tag manually or

with an optical bar code reader. At the gate, assuming a containerized aircraft, the pieces of baggage are loaded onto containers, which are then loaded onto the proper aircraft. At the conclusion of the flight, the process is reversed. For a non-containerized aircraft, the pieces of baggage are loaded directly onto the aircraft and, at the conclusion of the flight, the process is reversed.

Finally, the Reconciliation System should also include information regarding the cargo to be loaded onto the aircraft. The cargo is sorted and then loaded onto the proper container, assuming a containerized aircraft. The container is then routed to and loaded onto the proper aircraft. At the conclusion of the flight, the process is reversed. For the purpose of this application, discussions involving baggage should be construed to include cargo unless otherwise specified.

Passenger, Baggage and Cargo Reconciliation Systems of today are unreliable for the following reasons. As mentioned above, a record of a passenger checking in at the gate gives no assurance that the passenger is actually on board the aircraft. A more reliable mechanism to determine which passengers are on board is required. From the baggage perspective, there are several problem areas. First, the bar code on the baggage tag are not a reliable source of information because the baggage tag may wrinkle and fade due to frequent handling, thereby causing a significant percentage of attempts to read bar codes ending in failure. For a piece of baggage that has been through one or two "hops", and has therefore been handled frequently, it is not uncommon for the percentage of bar codes that can be successfully read to be near 50%. Bar codes unsuccessfully read must be manually processed, therefore adding expense, time and human error. Second, once the bar code is read (either manually or with the optical bar code reader), there is no guarantee that the piece of baggage is actually loaded onto the correct aircraft, or even loaded onto any aircraft. It could be overlooked at the gate, loaded onto the wrong container, or the container could be loaded onto the wrong aircraft. Third, after the piece of baggage is loaded, if the associated passenger does not board the aircraft, it may become necessary to unload that piece of baggage for safety reasons, e.g., prevention of the placement of bombs on an aircraft by a terrorist. In such a situation, the airline either finds the passenger and have that passenger board the aircraft, or the airline unloads the corresponding piece of baggage. Depending on the Reconciliation System used, it may not be easy to determine where in the aircraft a piece of baggage is located. Therefore, valuable time could be lost searching for a particular piece of baggage. On some international flights, this process could delay a flight by as much as two hours.

There are elements of today's technology which could be of benefit in solving some of the aforementioned problem. The following are some examples. A passenger's boarding pass include a magnetic stripe which identifies that passenger, wherein the magnetic stripe is read into an airline's computer system as that passenger boards the aircraft. Such a system is now being deployed by some airlines. The bar code of the baggage tag could also include information that identifies each piece of baggage in a manner similar to a social security number. This information could be read into the airline's computer system as the baggage is either freeloaded onto the aircraft or the container. Likewise, the container could also be identified with a bar code and read into the airline's computer system as it is loaded onto the aircraft. An association could be made on the airline's computer system to indicate which pieces of baggage are associated with each passenger, and whether the passenger has boarded the aicraft and/or the associated pieces of baggage have been loaded onto the aircraft.

The above-mentioned solution, however, is costly in terms of staff effort and time -- especially with respect to the baggage and cargo portions of the solution. In the above-mentioned solution, each element of cargo or baggage must be individually and successfully scanned, thereby leading to significant overhead. In addition, the bar codes deteriorate after they have been repeatedly handled making them more difficult to successfully scan.

One prior art Reconciliation System uses machine readable labels on the passenger's boarding pass and on the baggage tag that supports a computer system performing reconciliation functions. In such a system, the machine readable labels generally store little information, such as information similar to the "license plate" mentioned above. In another prior art Reconciliation System, an identification tag readable with electromagnetic is attached to the baggage tag. This prior art Reconciliation System integrates a specific design of a paper baggage tag with electromagnetic reading capability. In all of these prior art Reconciliation Systems, the passenger and baggage tags are "read-only" and hold relatively little data and rely on a central database to perform the reconciliation functions. Furthermore, the prior art Reconciliation Systems do not provide a direct way to determine the specific container in which a piece of baggage has been loaded. In the event a particular piece of baggage must be removed from the flight, it is imperative that the location (i.e., which container) of the baggage be known.

Accordingly, there exist a need for a Reconciliation System that has very high reliability in reading data, no manual intervention required to read such data, and the ability to integrate passengers, baggage, cargo, and containers using a single communication infrastructure.

Summary of the Invention

The present invention discloses a communication system that includes a radio frequency identification using modulated backscattering. In one embodiment,

the communication system is used for the reconciliation of passengers, baggage and cargo on a transport. Specifically, the communication system comprises interrogators for transmitting downlink signals and receiving uplink signals, and tags for receiving the downlink signals and transmitting the uplink signals. The tags are operable to demodulate a first information signal from a downlink signal and generate a second information signal having a data rate f, wherein the contents and data rate f of the second information signal depends on the contents of the first information signal. Subsequently, the second information signal and a subcarrier signal is used to generate an output signal, which is used to modulate backscatter the downlink signal.

In one embodiment, the tag includes a modulator that generates an output signal by modulating the second information signal onto the subcarrier signal if the second information signal is not a single bit message. If the second information signal is a single bit message, the modulator generates an output signal that is an unmodulated subcarrier signal. In another embodiment of the present invention, the interrogators include a narrowband filter for filtering noise from the uplink signals.

In one embodiment, the downlink signal includes an interrogation signal which instructs one or more tags receiving the downlink signal to transmit an uplink signal which includes data stored in a memory of the tag. In another embodiment of the invention, the downlink signal includes a tag address and a location signal which instructs the tag corresponding to the tag address to transmit an uplink signal that can be used to locate the tag. In another embodiment, the downlink signal includes a tag address and data which is to be stored in the tag corresponding to the tag address.

Brief Description of the Drawing

The features, aspects, and advantages of the present invention will become better understood with regard to the following description, appended claims, and accompanying drawings where:

FIG. 1 shows a block diagram of an illustrative Radio Frequency Identification (RFID) system;

FIG. 2 shows a block diagram of an illustrative Interrogator Unit used in the RFID system of FIG. 1;

FIG. 3 shows a block diagram of a Tag Unit used in the RFID system of FIG. 1;

FIG. 4 shows the relationships among the Interrogation, Location Mode, and Messaging Mode Ranges;

FIG. 5 shows the relationships among the Uplink Range for the Interrogation, the Uplink Range for the Messaging Modes, and the downlink Range for all three Modes;

FIG. 6 shows a Radio baggage tag;

FIG. 7 shows a block diagram of the electronics of the Radio baggage tag of FIG. 6;

FIG. 8 shows how a Cargo Container, with an attached Container Tag, is identified and loaded onto an Aircraft; and

FIG. 9 shows a Passenger entering a Gateway that leads to an aircraft, and how the Passenger is identified.

Detailed Description

The present invention is a Reconciliation System having a Radio Frequency Identification (RFID) system using Modulated Backscatter (MBS). In one embodiment of the present invention, the Reconciliation System utilizes Tags that are capable of transmitting data at various data rates, wherein the slower data rates extend the range of the Reconciliation System, as will be described herein.

RFID Systems

Radio Frequency Identification (RFID) systems are used for identification and/or tracting of equipment, inventory, or living things. RFID systems are radio communication systems that communicate between a radio transceiver, called an Interrogator, and a number of inexpensive devices called Tags. In RFID systems, the Interrogator communicates to the Tags using modulated radio signals, and the Tags respond with modulated radio signals. Specifically, the Interrogator transmits an amplitude modulated signal to the Tag, and then transmits a Continuous-Wave (CW) radio signal to the Tag. The Tag modulates the CW radio signal using Modulated BackScattering (MBS) where the antenna is electrically switched, by a Tag's modulating signal, from being an absorber of RF radiation to being a reflector of RF radiation, thereby encoding a Tag's information onto the CW radio signal being reflected. The Interrogator demodulates the incoming CW modulated radio signal and decodes the Tag's information.

MBS Operation

Referring to FIG. 1, there is shown an overall block diagram of a Radio Frequency Identification (RFID) system in accordance with one embodiment of the present invention. As shown in FIG. 1, an Application Processor 101 communicates over a Local Area Network (LAN) or Wide Area Network (WAN) 102 to a plurality of Interrogators 103 which, in turn, communicate with one or more Tags 105. Referring to FIG. 2, there is shown a block diagram of an illustrative Interrogator 103 As shown in FIG. 2, a processor 200 receives an Information Signal 101a from the LAN 102. The processor 200 subsequently formats the Information Signal 101a into an Information Signal 200a. A Modulator 202 modulates the Information Signal 200a onto a Radio Signal 201a (also referred to herein as a "carrier signal") generated by a Radio Signal Source 201, thereby creating a First

Modulated Signal 202a (also refereed to herein as a "Modulated Carrier Signal") which is then transmitted by a Transmitter 203 via Antenna 204. Upon transmission of the First Modulated Signal 202a, the Interrogator 103 then transmits a continuous wave (CW) radio signal. Transmission from the Interrogator is referred to herein as a Downlink. Thus, the transmitted First Modulated Signal and CW radio signal constitutes a Downlink Signal 204a.

In one embodiment, the First Modulated Signal 202a is transmitted using amplitude modulation. In this embodiment, amplitude modulation is chosen because amplitude modulated signals can be demodulated by the Tag with a single inexpensive nonlinear device such as a diode.

Referring to FIG. 3, there is shown a block diagram of an illustrative Tag 105. As shown in FIG. 3, the Tag 105 includes an Antenna 301, such as a loop or patch antenna, for receiving the Downlink Signal 204a transmitted by the Interrogator 103. The First Modulated Signal of the Downlink Signal 204a is demodulated, directly to baseband, using a Detector/Modulator 302 -- that is, the resulting demodulated signal 302a is essentially the Information Signal 200a. In one embodiment, the Detector/Modulator 302 is a microwave diode, such as the well-known Schottky diode. To minimize signal loss of the First Modulated Signal, the Detector/Modulator 302 should be appropriately biased with the proper current level in order to match the impedance of the Antenna 301 to the Detector/Modulator 302.

The Demodulated Signal 302a is then amplified by an Amplifier 303 and synchronization recovered in a Clock and Frame Recovery Circuit 304. The resulting Recovered Signal 304a is sent to a Processor 305, where the Recovered Signal 304a is analyzed - that is, the Processor 305 examines the content of the Information Signal 200a. Note that the Processor 312 includes a crystal oscillator 312 for providing timing information. In one embodiment, the Processor 305 is typically an inexpensive 4- or 8-bit microprocessor, and the Clock and Frame Recovery Circuit 304 is implemented in an ASIC (Applied Specific Integrated Circuit) which cooperates with the Processor 305. For purposes of this application, the term processor includes, but is not limited to, processors, micro-processors, and ASICs.

Depending on the content of the Information Signal 200a, the Processor 305 then generates another Information Signal 306 to be sent from the Tag 105 back to the Interrogator 103. The Information Signal 306 is provided as input to a Modulator Control Circuit 307, which uses the Information Signal 306 to modulate a Subcarrier Signal 308a generated by a Frequency Source 308. In one embodiment, the Frequency Source 308 is derived from the crystal oscillator 312, or is a crystal oscillator separate from the Processor 305. In another embodiment, the frequency source is derived from signals present inside the Processor 305 -- such as a divisor of the primary clock frequency of the Processor.

The Modulated Control Circuit 307 outputs a Modulated Subcarrier Signal 311, which is used by the Detector/Modulator 302 to modulate the CW radio signal of the Downlink Signal 202a, thereby producing a Modulated Backscatter (e.g., reflected) Signal 301a. Note that transmission from the Tag to the Interrogator is referred to herein as an Uplink. Thus, the Modulated Backscatter Signal constitutes an Uplink Signal.

In one embodiment, the presence of the Modulated Subcarrier Signal 311 (or lack thereof) causes the Detector/Modulator 302, e.g., Schottky diode, to change the reflectance, i.e., impedance, of the Antenna 301 -- for example, the impedance of the antenna is changed from zero to infinity.

Power is provided to the circuitry of the Tag by a power source 310. For purposes of this application, the term "power source" includes, but is not limited to, batteries and devices operable to transform microwave or magnetic energy into electrical energy, such as rectifiers and inductive couplings.

It has been found that considerable advantages are present to an MBS design that uses a single frequency subcarrier. Many modulation schemes are possible. These modulation schemes include, but are not limited to, Phase Shift Keying (PSK) of the subcarrier (e.g., BPSK, QPSK) and more complex modulation schemes (e.g., MSK, GMSK).

Referring back to FIG. 2, the Interrogator 103 receives the Uplink Signal 301a with a Receive Antenna 206, amplifies the Uplink Signal 301a with a Low Noise Amplifier 207, thereby obtaining an Amplified Signal 207a. The Amplified Signal 207a is provided as input to a Mixer 208, which uses homodyne detection to demodulate the Amplified Signal 207a down to the intermediate frequency (IF) corresponding to the subcarrier signal 308a (frequency f_s) -- that is, the Radio Signal 201a is used to demodulate the Amplified Signal 207a to obtain a Demodulated Signal 209, which is essentially the Modulated Subcarrier Signal 311. Note that such homodyne detection has advantages in that it greatly reduces phase noise in the receiver circuits. Subsequently, the Mixer 208 sends the Demodulated Signal 209 into a Filter/Amplifier 210 where the Demodulated Signal 209 is filter The resulting Filtered Signal 211 is then demodulated in a Subcarrier Demodulator 212 to obtain an Information Signal 213, which is essentially the Information Signal 306. The Information Signal 213 is provided as input to a Processor 200 to determine the content of the Information Signal 213. Note that if the Mixer 208 is a Quadrature Mixer, the Mixer 208 will send both I (in phase) and Q (quadrature) signals. In such a case, the I and Q channels of Demodulated Signal 209 can be combined in the Filter/Amplifier 210, in the Subcarrier Demodulator 212, or in the Processor 200.

In an alternate embodiment of the present invention, the Interrogator includes a single antenna for transmitting and receiving radio signals. In this embodiment,

an electronic method of separating the transmitted signal from that received by the receiver chain is needed. This could be accomplished by a device such as a Circulator, which is well-known in the art.

The present invention includes several implementations of the Subcarrier Demodulator 212. These implementations include, but are not limited to, conventional analog I/Q demodulation of the subcarrier signal using, e.g., a Costas Loop, Digital Signal Processing (DSP) of the sampled subcarrier, or implementing a receiver in digital logic. Since minimizing the system cost is one objective, one embodiment of the present invention implements the Subcarrier Demodulator in digital logic.

Range Extension

The performance of the present invention can be enhanced by extending the range of the RFID system. Essentially, this involves extending the ranges of the Downlink and the Uplink. Extending the range of the Downlink involves several factors. First, the range of the Downlink can be extended by minimizing signal loss. As mentioned earlier, in one embodiment, the Downlink is an amplitude modulated signal which is easily and inexpensively detected by a Detector/Modulator that is a single nonlinear device, such as a microwave or Schottky diode. To minimize signal loss from the antenna 301 to the nonlinear Detector/Modulator, it is important to match the impedance from the antenna to the diode. Second, the data rate of the Downlink can be limited to reduce the noise bandwidth of the Downlink signal. Third, the Antenna 301 of the Tag can be used to filter out RF signals outside of the antenna bandwidth (in additional to receiving RF signals). For example, at 2.45 GHz, allowable RF carrier frequencies are from 2.400 - 2.485 GHz. The design of the antenna, such as a patch antenna, covers this frequency band but filters out frequencies beyond this range. An ideal frequency response would be for antenna sensitivity to be within 3 dB across the allowable frequency range, but to fall off rapidly beyond this range. Furthermore, the Amplifier 303 can also act as a filter in the sense that the Amplifier can be designed to only pass signals that are within a certain passband around the expected Downlink data rate, which typically ranges from a few kilobits per second up to tens of kilobits per second The above-described Tag design is not greatly sensitive to RF transmissions inside the frequency band of the antenna, whose modulation scheme is primarily a constant envelope. Thus, such Tag design allows a robust Tag which is resistant to many potential interfering signals.

Extending the range of the Uplink also involves several factors. First, the noise bandwidth of the Uplink signal could be reduced by decreasing the data rate as much as possible. The number of useful applications that can be implemented is not limited if the data rate of the Uplink signal is limited to a few bits per second. The limitation of the data rate can be taken to the extreme in which there is no data modulated onto the single subcarrier frequency. In such a case, the mere presence or absence of a signal received at this subcarrier frequency can indicate an "acknowledgment" or "no acknowledgment" to a previous message. Second, the range of the Uplink can be extended using narrowband filtering of a subcarrier signal, wherein the subcarrier signal can be relatively accurately determined. In one embodiment, the frequency source 308 generates a subcarrier signal with a relatively accurate frequency. For example, the Frequency Source 308 can be a commercially available and inexpensive crystal oscillator with a frequency of 32kHz, and an accuracy of ± 100 ppm -- that is, the frequency of the crystal oscillator is known to within ± 3.2 Hz. In one embodiment, narrowband filtering is implemented in the Interrogator using a processor 210a, such as a digital signal processor (DSP), that performs the functions of the Filter Amplifier 210 and the Subcarrier Demodulator 217. In this embodiment, the processor 210a uses narrowband filtering algorithms, which are well-known in the art, to perform digital filtering of the signal with a bandwidth of less than 10 Hz, and first sidelobes that are depressed 60 dB. Then, the signal strength of the signal received through this digital signal processor 210a is measured, and that strength is compared to a reference signal strength which is sufficiently above the average noise in that channel when no signal is present such that spurious noise spikes are not misinterpreted as actual signals. In this manner, very weak Uplink signals can be reliably detected. It has been found that, using these techniques, roughly equivalent range in the Downlink and the Uplink can be achieved.

We now discuss the location of the subcarrier frequency f_ss. MBS systems exhibit noise in the Uplink signals due to reflections of the RF source from any number of reflectors. There are typically two categories of reflectors: reflectors that reflect signals at the same carrier frequency at which the signal was transmitted, and reflectors that reflect signals at frequencies away from the carrier frequency at which the signal was transmitted. The former category includes walls and metal objects. Signals reflected from these reflectors have an arbitrary phase relationship with respect to the carrier signal. To cancel the reflections, a Quadrature Mixer 208 operating as a Homodyne Detector is used. The latter category of reflectors generates reflected noise at frequencies away from the main carrier frequency -- either from Doppler shifts (caused by moving metallic objects) or from reflections off of electronic equipment operating at frequencies near the Subcarrier Frequency. One particularly difficult source of noise is fluorescent lights, which have been shown to produce noise not only at their fundamental 60 Hz (in the United States) frequency, but also at overtone frequencies well up into the tens of thousands of Hertz. It has been found especially helpful to locate the subcarrier frequency f_s such that it falls between multiples of the fundamental 60 Hz

frequency. In one embodiment, a 32 kHz crystal oscillator is used to generate a subcarrier frequency that meets this requirement.

Multiple Mode Operation

In one embodiment, the Reconciliation System is capable of multi-mode operation. In this embodiment, the Tags and Interrogator are operable to transmit data at a high data rate and a low data rate. Note that other data rate modes are also possible, and the present invention should not be construed to be limited to the two aforementioned data rates. In one embodiment of the present invention, actual data messages, e.g., multi-bit or high bit messages, are transmitted and received by the Reconciliation System using the high data rate mode, and acknowledgment messages, e.g., single or low bit messages, are transmitted and received by the Reconciliation System using the low data rate mode.

Advantageously, the low data rate mode provides the Reconciliation System of the present invention with enhanced range. As discussed earlier, the low bit rate mode is used to transmit the acknowledgment messages which are typically one bit or relatively low bits. Because of this fact, the acknowledgment messages could be transmitted over smaller frequency bands than actual data messages. Smaller frequency bands permit the application of narrowband filtering of noise outside the frequency band, thereby enhancing the range the acknowledgment message could be transmitted.

As discussed above, to send a single bit of information, the Tag could generate an unmodulated subcarrier frequency which could be modulated onto the incident signal, i.e., reflected continuous wave radio signal, using modulated backscatter. The Interrogator would then receive a reflected signal with a single frequency tone. Narrowband filtering techniques could then be used to reduce the noise bandwidth and determine the presence or absence of this signal.

In operation, the Tag 105 detects and assembles the bits of Information sent from the Interrogator 103 as a Downlink message. Typically, a pattern of synchronization bits is transmitted at the beginning of the Downlink message. These bits allow the Tag to acquire bit and message synchronization, thereby enabling the Tag to determine the beginning and the end of the Downlink message. In one embodiment, the Downlink message includes an Address, a Command, and perhaps Data and Error Detect and/or Correct. The Command or Data portion of the Downlink message should indicate whether the Tag 105 is to return an actual data message, such as a Tag ID or other application-specific data, or an acknowledgment message, such as a single-bit acknowledgment message.

The Processor 305 of the Tag 105 determines what type of Uplink signal is to be transmitted back to the Interrogator. There are several ways that the Tag 105 may transmit either an actual data message or an acknowledgment message so that the Interrogator 103 can receive and distinguish between these two different types of messages. Referring back to FIG. 3, in one embodiment, the Information Signal 306 is transmitted from the Processor 305 to the Modulator Control 307 over a lead 306a. In the event that Processor 305 of Tag 105 is to send a "single tone" message consisting of a single information bit, the lead 306a is maintained in a first logic state to indicate that no information message is to be sent, thereby causing the Modulator Control 307 to output an unmodulated subcarrier signal 311. In the event that Processor 305 determines that an actual data message is to be sent, the lead 306a conveys the actual data message to the Modulator Control 307. This actual data message is then used to modulate the subcarrier signal 308a using one of several possible modulation techniques, such as amplitude, phase, frequency, or code modulation.

Referring back to FIG. 2, the Interrogator 103 receives and demodulates the modulated (or unmodulated) subcarrier signal from the received Uplink signal, and then applies filtering. Given the specifics of the subcarrier frequency, a suitable filtering amplifier 210 is utilized to filter out noise. Subcarrier Demodulator 212 then demodulates the Information Signal 306, if any, from the modulated (or unmodulated) subcarrier signal. The Processor 200 then performs the digital signal processing necessary to decode the information signal 306. In one embodiment of this invention, the Processor 200 may be a Digital Signal Processor (DSP). In other embodiments, a conventional Microprocessor could be used as the Processor 200.

To recover a "single tone" acknowledgment message having a single subcarrier tone, the filtering amplifier should be a narrowband filter. While conventional filter technologies could be used, it may be most effective to utilize the DSP 210a mentioned above as a narrowband filter. The subcarrier frequency of this single tone is well known since the Tag 105, in one embodiment, would typically use an inexpensive crystal as the frequency source. Even with the limited accuracy of that crystal, the subcarrier frequency could be known to an accuracy of a few Hertz, therefore allowing very narrowband filtering. Since the acknowledgment message response from Tag 105 is used to extend the range of the RFID system and consequently would likely be a very faint signal, it places an additional burden on the narrowband filter of filtering amplifier 210.

Another way that the DSP mentioned above could be used is to dynamically search for the frequency components of the Uplink signal. This could be accomplished by performing a Fourier Transform on the incoming data stream, in one embodiment, using the Processor 200 of FIG. 2. In this embodiment, the multiple signals representing a modulated subcarrier signal could be differentiated or a single subcarrier signal of uncertain data rate could be recovered using the Fourier Transform to search for multiple signals.

Thus, we have shown how a modulated backscatter communication system can operate in two modes --one in which the backscattered signal is modulated to provide a high data rate Uplink communication channel, and one in which the backscattered channel is modulated with a low data rate signal, perhaps a single tone, to provide an Uplink acknowledgment signal that can be detected at great distances.

Multi-Mode Implementation

In one embodiment, the multi-mode operation of the present invention Reconciliation System is implemented into three services. The first service to be discussed is referred to herein as "Interrogation" service. Interrogation begins with the Interrogator transmitting a Downlink referred to herein as an Interrogation Signal to the Tag. The Tag decodes the received Interrogation Signal and determines what actions to take based upon the decoded Interrogation Signal. In a "standard" Interrogation, the Tag would be requested to transmit a set of data referred to herein as Mandatory Data back to the Interrogator using MBS. Each Tag in a reading field of an Interrogator that receives the "standard" Interrogation responds with its Mandatory Data, using a protocol discussed herein. Note that the term "reading field" is defined as the area of space within which the Tag and the Interrogator can communicate. The Interrogator also transmits, as part of the "standard" Interrogation service, data intended for each and all Tags. Examples of such data include time of day, framing and other synchronization information, etc. In one embodiment, the Mandatory Data includes identification information

Beyond the "standard" Interrogation, other types of Interrogations are possible as well. For example, the Interrogator, after identifying a specific Tag using the Interrogation, could transmit additional data to that Tag to be stored in the Tag's memory. The Interrogator could also request the Tag transmit other data, stored in the Tag's memory, back to the Interrogator. These additional data communications could be performed at the same data rate used in the "standard" Interrogation. Thus, Interrogation could be used to transmit commands and data to each and every Tag, to identify a specific Tag in the reading field, and to communicate bi-directionally with a specific Tag. In Interrogation, the data rate required in the Downlink is typically not large, since the Interrogation Signal only must contain enough bits to request all Tags in the reading field to respond. In the Uplink, the amount of data is typically much larger than the amount of data in the Downlink. Since the Mandatory Data must frequently be transmitted in the Uplink in a time critical manner, the data rate should therefore be much higher in the Uplink than the Downlink -- that is, there exist asymmetry in data rates between the Uplink and Downlink in the sense that the Downlink data rate is smaller than the Uplink data rate.

The second service is referred to herein as "Location." The Location service is used by the Reconciliation System to locate the position of a Tag. In Location, the Interrogator transmits a Downlink referred to herein as a Location Signal to the Tag containing the address of a specific Tag to which the Location Signal is directed. In this service, the Tag is requested to respond, one embodiment, with a simple acknowledgment message, such as a constant tone signal. Using the narrowband techniques discussed above, a constant tone signal can be received by the Interrogator at a range far beyond the range of the Interrogation service. Therefore, in the Location service, there exist an asymmetric communications path where the Downlink has a greater data rate than the Uplink.

In one embodiment, the Location service is used to determine the location of a specific Tag 105 as follows. Let us assume that the Reconciliation System currently has no information as to the location of a Tag. The Interrogators of the Reconciliation System transmit location Signals and then listen for possible responses, i.e., acknowledgment messages. In one embodiment, each Interrogator is operable to determine the signal strength of the received response (if any) and reports their determination to a location process residing on the LAN 102 or Application Processor 101, wherein the location process is a software process operable to determine the location of a Tag based on the signal strength of the acknowledgment messages being reported to the location process by the Interrogators. In one embodiment, the location process determines the location of the Tag is equal to the location of the Interrogator receiving the strongest acknowledgment message signal strength, wherein the accuracy of the Tag's location is the effective range of that Interrogator. In another embodiment, the location process utilises a more complex method to determine a Tag's location if more than one Interrogator received an acknowledgment message. In this embodiment, the location of the Tag can be determined based on which Interrogator received an acknowledgment message and the spatial position of each Interrogator. For example, if two Interrogators received an acknowledgment message of equal signal strengths, then the Tag's position could be estimated at halfway between those two Interrogations. If three Interrogators received an acknowledgment message, then a "triangulation" could be performed. See "The NLOS Problem in Mobile Location Estimation Proceeding 1996 5th International Conference on Universal Personal Communic. Oct 96" by Marilynn Wyle and Jack Holtman.

The third service is referred to herein as "Messaging." In Messaging, a Downlink referred to herein as a Messaging Signal containing the address of one or more Tags and data intended for those Tags is transmitted by the Interrogators. The Tag or Tags whose address matches the Tag address or addresses in the Messaging Signal could be instructed to store that data in a memory associated with the Processor 305, such as memory 305a, or perform some other function with

that data. There appropriate Tags could respond to the Messaging Signal in one of several manners. If the Messaging Signal instructs the Tag to store the data, the Tag acknowledges receipt of the Messaging Signal by returning an acknowledgment message to the Interrogator. Alternatively, if the Messaging Signal instructs the Tag to make a decision, or to transmit other data back to the Interrogator, then the response could be an acknowledgment message with a few bits of data. Thus, in Messaging, there exist an asymmetric communications path where the Downlink has a greater data rate than the Uplink if the Uplink is an acknowledgment message. If the Uplink is an actual data message, there will typically exist an asymmetric communications path where the Downlink has a smaller data rate than the Uplink.

In an alternate embodiment, it is possible for a communication to begin in one of the above services and change into another service. The following is an illustration of such a possible communication. Assume communication with a Tag is desired. A Messaging Signal is transmitted from the Interrogator to the Tag instructing the Tag to respond with a simple acknowledgment, which is received by the Interrogator. Further assume that, based upon the acknowledgment message received by the Interrogator, the Interrogator wishes to instruct the Tag to transmit additional data back to the Interrogator. For example, the Interrogator determines the signal strength of the acknowledgment message and, if the signal strength is below a certain threshold, limits the Uplink data rate to the data rate normally used in the Uplink for the Messaging service. Otherwise the signal strength is above a certain threshold and the Interrogator changes the Uplink data rate to the data rate normally used in the Uplink for the Interrogation service. It should be understood that, while the above example showed how the Uplink communications could take place at either one of two possible Uplink data rates, other Uplink data rates are possible.

In one embodiment of the present invention, all three services discussed above can coexist in the same system and be operational at the same time. We begin with the realization that these services, based upon the required data rates, support different ranges from the Interrogator to the Tag. For example, the Interrogation service involves significant data transmission over (relatively) short time periods, such as when a Tag moves by an Interrogator. The required data rate is further increased if there are several Tags in the reading field at one time. When there are multiple Tags transmitting data simultaneously, a protocol is required to allow multiple Uplinks without mutually interference. In one embodiment, the protocol used is Aloha or Slotted Aloha. Typical data rate for the Interrogation service range from 50 kbps - 300 kbps. Note that, in the absence of other factors, range and data rate trade off against each other. See "Queuing Systems Vol. 2 Computer Applications" by Leonard Kleinrock, published by John Wiley & Sons, NY in 1976.

In summary, there exist two different "asymmetries" in data rates: greater data rates for Uplink than Downlink in the Interrogation service, and greater data rates for Downlink than Uplink in the Location and Messaging services. Thus, the effective range for the Interrogation service is smaller than that of the Location or Messaging services because the Uplink data rate requirement is greater in the Interrogation service. This difference in ranges is illustrated in FIG. 4. It is important to observe the relationships between these data rates. In the "Range Extension" section above, it was disclosed how to achieve significant range extension using, among other techniques, narrowband filtering. In one embodiment, the Location and Messaging services roughly have a Downlink data rate of a few kilobits per second and an Uplink data rate of a few bits per second. The Interrogation service has roughly a Downlink data rate of a few kilobits per second and an Uplink data rate of 50 kbps - 300 kbps.

Referring to FIG. 5, there is shown an illustration of the relationship between the ranges for these three services. As shown in FIG. 5, the Downlink range 503 is the same for all three services. The Uplink range 502 for the Location and Messaging services is roughly the same as the Downlink range 503. By contrast, the Uplink range 501 for the Interrogation service is much smaller than the Uplink range 502.

Note that the above discussion ignores the effects of directional antennas. In some Interrogation applications, it is appropriate to use directional antennas to increase effective range, and to form a "reading field" whose shape and size is optimized to that application. The above discussion has been general, and implicitly assumes that all thee services use the same antenna technology. The use of different antenna patterns will be discussed herein.

RFID System Architecture

At this point, the placement of the Interrogators will now be discussed. Referring back to FIG. 1, the Application Processor 101 is operable to support a Database 110 that stores information regarding passenger, baggage and cargo. For example, the Database 110 includes information about the identity of the passengers on board an aircraft, the passengers' associated baggage, the location of the baggage, etc. In one embodiment, the Interrogators are distributed throughout the airport complex. For purposes of discussion, it is assumed that the coverage throughout the airport complex for the Interrogation service is not complete, i.e., the Interrogation service is only available in certain well defined areas of the airport complex. This assumption is justified since the Interrogation service is generally used to identify Tags as they pass by a specific location (such as a doorway, etc.) It is further assumed that for the Location and the Messaging services, the coverage

of the airport complex is greater than the coverage for the Interrogation service. Ideally, it is desirable to provide Location and Messaging services to anyone in the airport complex.

For the Location or Messaging services, one embodiment of the present invention would be to place enough Interrogators in the airport complex such that any point in the airport complex is within the range of at least three Interrogators, thereby permitting the implementation of a Location service using triangulation of the received Uplink signal strength. In another embodiment, the Interrogators are placed in a "partially overlapping" fashion, such that any point in the airport complex is within the radio coverage area of at least one Interrogator. Given this configuration, a relatively simple Location service can be implemented, with the accuracy of the Location service comparable to the coverage area of one Interrogator.

Baggage and Cargo Identification

At this point, the distribution of the Tags will now be discussed. To support automated identification, one embodiment includes three types of Tags 105; a Radio baggage tag, a Container Tag, and an Aircraft Tag. These automated identification means supplement or replace methods in operation today, which includes manual sortation of optical bar codes.

Radio baggage tag

Referring to FIG. 6, there is shown a Radio baggage tag 610 in accordance with one embodiment of the present invention. As shown in FIG. 6, the Radio baggage tag 610 includes a Tag 105 which may have a luggage identification, a passenger identification, routing information, etc. Note that the Radio baggage tag 610 may also include a Bar Code License Plate 620 to provide routing and other information in airports where the Reconciliation System of the present invention is not available. To reduce the cost of the Radio baggage tag 610, several components of the Tag 105 may be eliminated. Referring to FIG. 7, there is shown a block diagram of a Tag 105-1 in accordance with one embodiment of the Radio baggage tag 610. As shown in FIG. 7, the Tag 105-1 includes an Antenna 701 and a single Integrated Circuit (IC) 710, which includes a Detector/Modulator 702, a Logic Control 704 and a Power Rectifier 703. In this embodiment, the Radio baggage tag 610 is a read-only Tag, and not a read-write Tag -- that is, the Tag 105-1 is only capable of responding to an Interrogation Signal, and the response provided to the Interrogation Signal is fixed, i.e., the Tag is "write once, read many."

The Tag 105 illustratively shown in FIG. 3 has been greatly simplified to arrive at the Tag 105-1 of FIG. 7. The Antenna 701 receives the incoming RF signal and power is supplied to the circuitry of the Tag 105-1 by the Power Rectifier 703, i.e., the Power Rectifier rectifies the incoming RF signal. The range at which the Radio baggage tag 610 can be powered is then the controlling factor in both the Downlink and the Uplink range. In one embodiment, the maximum range of the Tag 105-1 is two meters. Furthermore, since the Tag 105 is read-only (and not read-write), there is no need for a Processor as sophisticated as a 4 or 8 bit microprocessor, and custom logic, such as the Logic Control 704 can be substituted. Still further, since the data is written once and read many times, the Tag does not need an expensive on-chip re-writeable storage - that is, inexpensive fuses contained within the Logic Control 704 can be used. The Logic Control 704, upon detection of an incoming RF signal, then activates the Detector Modulator 702 to perform the modulated backscatter communications disclosed above. The Tag 105-1 of FIG. 3 can therefore be reduced to a Single IC 710 with an Antenna 701. Note that the Radio baggage tag 105-1 could also be used for the Location service. Further note that the initialization of the Radio baggage tag 610 includes writing into memory the data desired to be retrieved in the Interrogation service, e.g., associated passenger, identification number, etc. This initialization could be done during or after the process to print the Bar Code License Plate 620 onto the Radio baggage tag 610.

Container Tag

In one embodiment, the Container Tag is a read-write Tag 105. Preferably, the Container Tag is packaged in a rugged packaging, due to the environmental stresses placed upon it. Referring to FIG. 8, there is shown a Container 810 with a Container Tag 820 being loaded onto an aircraft via a cargo bay door 840. In one embodiment, the Container Tag 820 is operable to respond to Interrogation, Messaging, and Location services. The Container Tag 820 is designed to be affixed to the Cargo Container 810 (which could be a container or a pallet), so that the Cargo Container 810 can be identified as it passes though an entrance or egress to a cargo handling facility, and aircraft, etc., where an Interrogator will be typically positioned.

Because the Container Tag 820 has read-write capabilities, the Container Tag 820 may be used to store helpful data. For example, assume that pieces of baggage containing Radio baggage tags 610 are loaded into a Container 810 equipped with a Container Tag 820. The identification data can be read from the Radio baggage tag 610 by the Interrogator using the Interrogation service. Such identification data can be subsequently transmitted to and stored in the Container Tag 820 using the Messaging service. Thus, data concerning the contents of the Container 810 would be available though the Container Tag 820. Also note that the Container Tag could also be used in the Location service to locate misplaced, lost or stolen containers. This could be of benefit in an airport environment, since it may

happen for one airline to borrow a Container 810 from another airline, and not inform the other airline of the borrow.

Aircraft Tag

Aircraft Tags of the present invention can be used to determine whether baggage, cargo and/or containers have been loaded onto a particular aircraft. In one embodiment, the Aircraft Tag is a function equivalent to the Tag 105 of FIG. 3 --that is, the Aircraft Tag has read-write capabilities. Referring back to FIG. 8, a Container 810 is loaded onto an Aircraft 860 by the use of a Crane 850. Mounted onto the Aircraft 860 at or near the Cargo Bay Door 840 is an Aircraft Tag 830. In one embodiment, the Aircraft Tag 830 has Mandatory Data that identifies the Aircraft 860 and the Cargo Bay Door 840 being used. In operation, the Interrogator 105 on top of the Crane 850 could read the Aircraft Tag 830, thereby allowing the Reconciliation System to know the identity of the Aircraft 860 on which baggage, cargo and containers are being loaded and the identity of the Cargo Bay Door 840 being used. Thus, associations between the Aircraft 860, the Cargo Bay Door 840, the Radio baggage tag 610, and the Container Tag 820 can be made.

Passenger Identification

Referring to FIG. 9, there is shown a Passenger 1020 entering a Gateway 1010 to board an aircraft. The Passenger 1020 has an Identification means 1030. The Identification means 1030 can be, but is not limited to, a Boarding Pass 1001, a Radio Boarding Pass 1003, or a Passenger Card 1002.

Magnetic Boarding Pass

The Magnetic Boarding Pass 1001 is a device, in one embodiment the size of an airline ticket, with an attached magnetic stripe. The information on the Magnetic Boarding Pass 1001 can include the identification of the passenger, the flight number and seat number of this passenger, and other such data. When the Passenger 1020 enters the Gateway 1010, the Passenger must insert the Magnetic Boarding Pass 1001 into a Magnetic Card Reader 1060. A mechanism, such as a Turnstile 1040 or an Optical Sensor 1050, to restrict a person without a valid identification from boarding is preferred. In this embodiment, the Magnetic Card Reader 1060 reads the contents of the Magnetic Boarding Pass 1001, and transmits the identity of the Passenger 1020, or other such information, to the Applications Processor 101 of the Reconciliation System which, in turn, stores and/or processes the information into the Database 110.

Radio Boarding Pass

The Radio Boarding Pass 1003 is a device with an embedded Tag that is a functional equivalent to the Tag 105-1 of FIG. 7-- that is, the Radio Boarding Pass 1003 has a read-only Tag 105-1 containing the identification of the passengers, among other data. Thus, the identity of the Passenger 1020 can then be determined by an Interrogator 103 reading the Radio Boarding Pass 1003.

As disclosed below, using the incident RF field to power a Tag 105 will cause the effective range of that Tag 105 to be greatly reduced. Therefore, in order to read the Boarding Pass 1040 as the Passenger 1020 boards the aircraft, an Interrogator 103 should be located at the entrance of either the boarding ramp, or the entrance to the aircraft itself.

Passenger Card

The Passenger Card 1002 is a functional equivalent of the Tag 105-1 of FIG. 3 -- that is, the passenger card 1002 has read-write capabilities, i.e., data can be transmitted to the Card, stored on the Card, and retrieved from the Card. A Passenger Card 1002 would likely be initially issued to the Passenger 1020, and then re-used over numerous trips.

The Passenger Card 1002 is operable to respond to the Interrogation, Messaging, and Location services discussed above. Thus, using the Interrogation service, the identity of the Passenger 1020 boarding the aircraft can be determined; using the Messaging Mode, data can be transmitted to the Passenger Card 1002; and using the Location Mode, the location of the Passenger can be determined.

As the Passenger Card 1002 approaches the check-in counter, the Passenger Card 1002 could be interrogated by the Interrogator 103. The identity of the Passenger 1020 could then be determined, thereby allowing the attendants to greet the Passenger 1020 by name. In another embodiment of the Passenger Card 1002, the Passenger Card 1002 could contain information regarding the identification numbers of the pieces of baggage checked by this Passenger 1020, thereby facilitating retrieval of the baggage.

The Passenger Card 1002 could also be used by the Passenger 1020 to check in at an automated check-in station, such as a device similar to an Automated Teller Machine, thereby expediting airport check-in procedures. The automated facility could also provide seat assignment based upon preferences stored in the Passenger Card 1002.

What has been described is merely illustrative of the application of the principles of the present invention. Other arrangements and methods can be implemented by those skilled in the art without departing from the spirit and scope of the present invention.

Claims

1. A communication system comprising:

   transmitter interrogators for transmitting a downlink signal having a modulated carrier signal and a radio signal, wherein the modulated signal is generated by modulating a first information signal onto the radio signal;
   tags for receiving the downlink signal, demodulating the first information signal from the downlink signal and transmitting an uplink signal, wherein the uplink signal is generated by modulated backscattering an output signal onto the continuous wave radio signal, each of the tags including a modulator for generating an output signal which is dependent upon a second information signal having a data rate f; and
   receiver interrogators for receiving and demodulating the uplink signal.

2. The communication system of claim 1, wherein the transmitter interrogators include a first radio signal source to generate the radio signal and the receiver interrogators include a second radio signal source to demodulate the output signal from the uplink signal.

3. The communication system of claim 1, wherein the tag includes:

   a subcarrier demodulator for demodulating the second information signal from the output signal.

4. The communication system of claim 1, wherein the modulator generates a modulated subcarrier signal if the second information signal is not a single bit message, the modulator generating the modulated subcarrier signal by modulating the second information signal onto a subcarrier signal.

5. The communication system of claim 1 further comprising:

   a location process for determining locations of the tags based on signal strengths of uplink signals received by the receiver interrogators.

6. A communication system comprising:

   an antenna for receiving a downlink signal and reflecting an uplink signal, the downlink signal having a modulated carrier signal and a radio signal;
   a detector modulator for demodulating a first information signal from the modulated carrier signal and for generating the uplink signal by modulated backscattering an output signal onto the radio signal, the detector modulator being operable to change reflectance of the antenna;
   a processor for examining the first information signal and generating second information signals with at least two data rates;
   a frequency source for generating a subcarrier signal; and
   a modulator for generating the output signal using the subcarrier signal and the second information signal.

7. The communication system of claim 6, wherein the processor generates a second information signal that is a single bit data.

8. The communication system of claim 6, wherein the processor generates a second information signal that is a multi-bit data.

9. A communication system comprising:

   an antenna for receiving an uplink signal, wherein the uplink signal includes a radio signal modulated by an output signal;
   a radio source for generating the radio signal;
   a mixer for mixing down the uplink signal using the radio signal generated by the radio source to obtain the output signal; and
   a subcarrier demodulator for demodulating an information signal from the output signal if the output signal is a modulated subcarrier signal.

10. The communication system of claim 9 further comprising:

    a processor for providing a second information signal; and
    a modulator for generating a modulated radio carrier signal by modulating the second information signal onto the radio carrier signal generated by the radio signal source.

FIG. 1

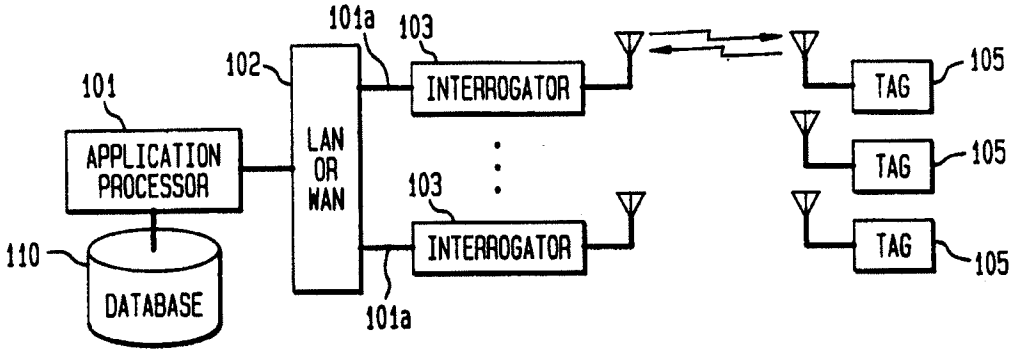

101a
103
102
INTERROGATOR
TAG
105
101
APPLICATION PROCESSOR
LAN OR WAN
TAG
105
103
110
INTERROGATOR
TAG
105
DATABASE
101a

FIG. 2

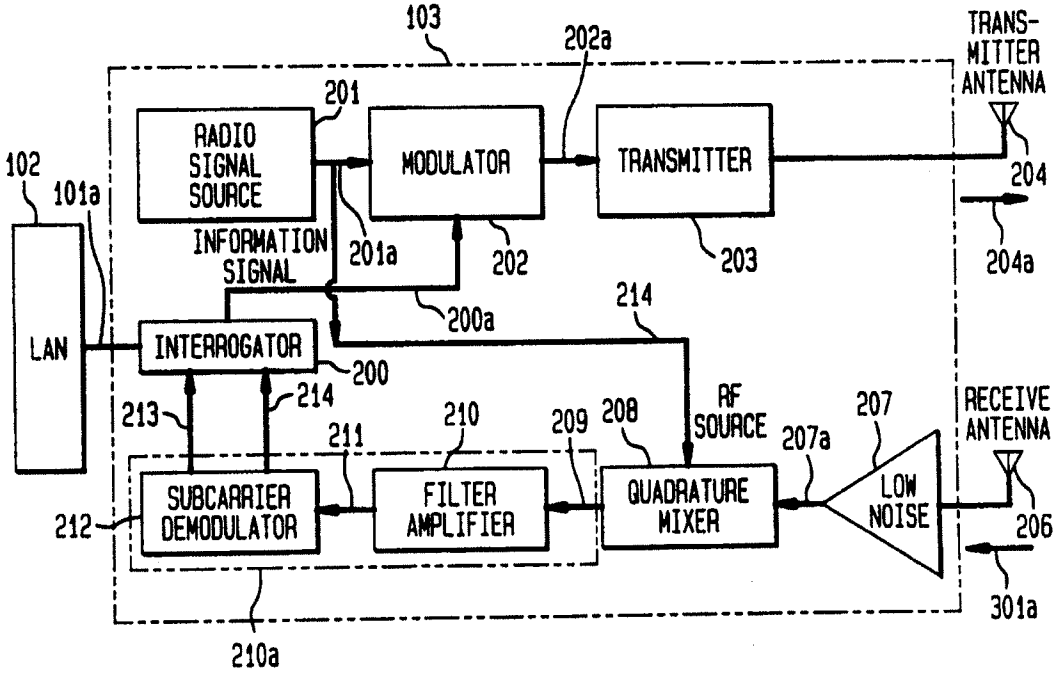

103
202a
TRANS-MITTER ANTENNA
201
RADIO SIGNAL SOURCE
MODULATOR
TRANSMITTER
102
101a
204
INFORMATION SIGNAL
201a
202
203
204a
200a
214
LAN
INTERROGATOR
200
214
213
RF SOURCE
207
RECEIVE ANTENNA
211
210
209
208
207a
SUBCARRIER DEMODULATOR
FILTER AMPLIFIER
QUADRATURE MIXER
LOW NOISE
212
206
301a
210a

FIG. 3

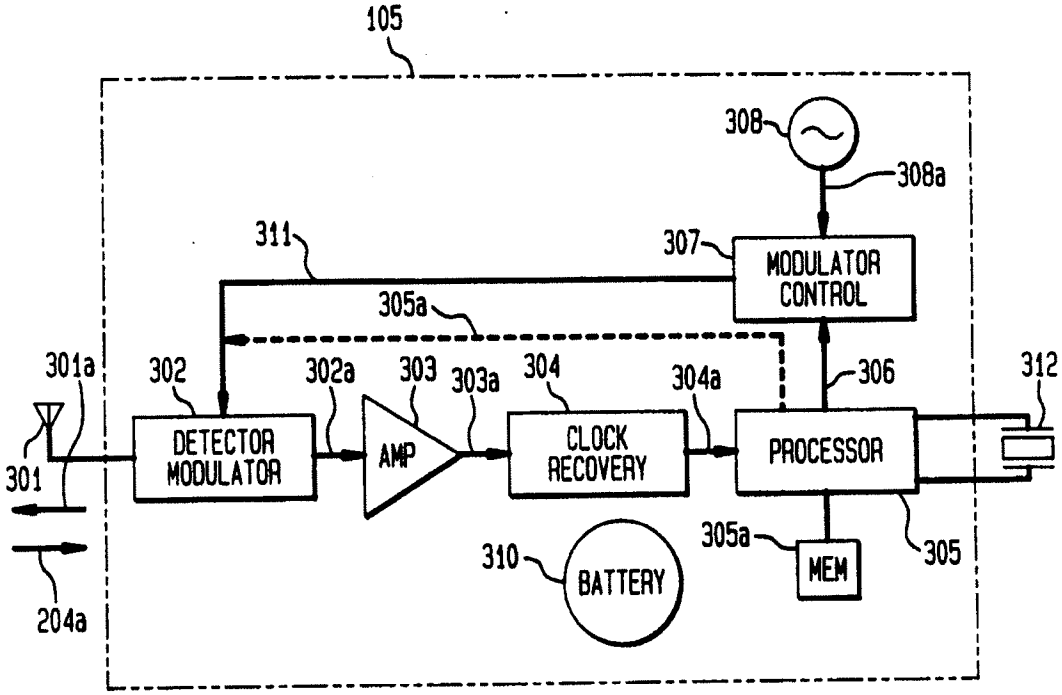

105
308
308a
311
307
MODULATOR CONTROL
305a
301a
302
302a
303
303a
304
304a
306
312
DETECTOR MODULATOR
AMP
CLOCK RECOVERY
PROCESSOR
301
310
BATTERY
305a
MEM
305
204a

FIG. 4

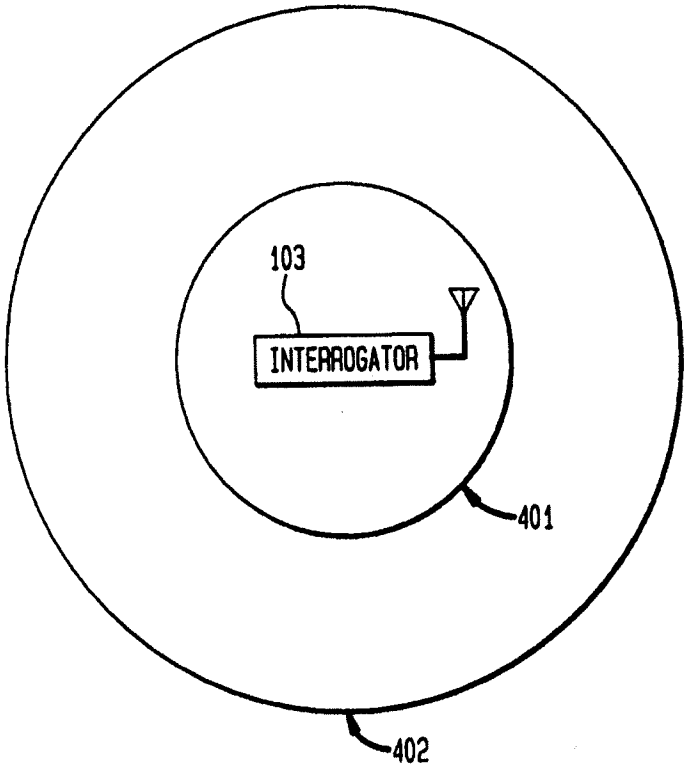

103
INTERROGATOR
401
402

FIG. 5

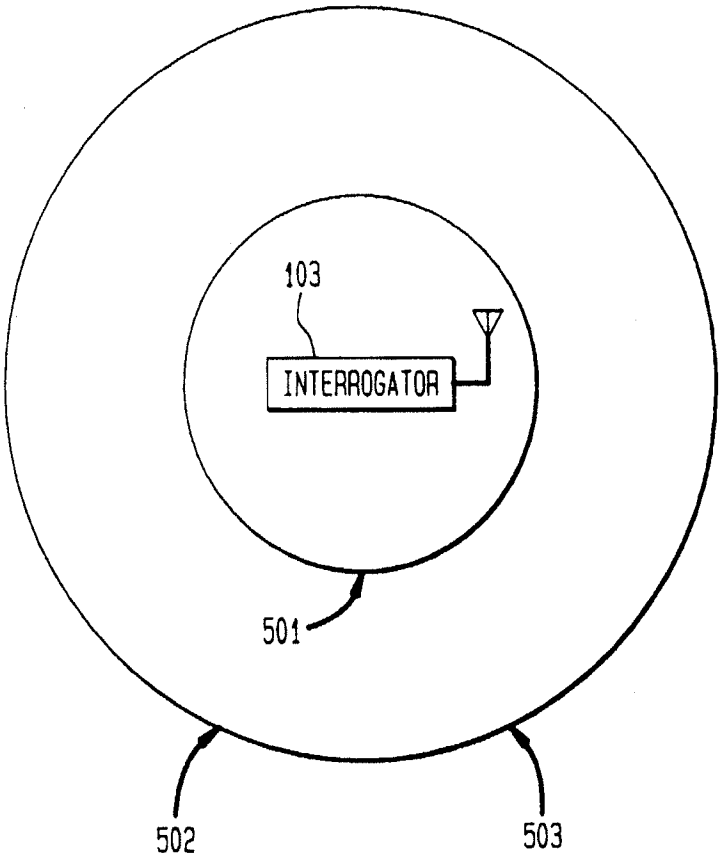


FIG. 6

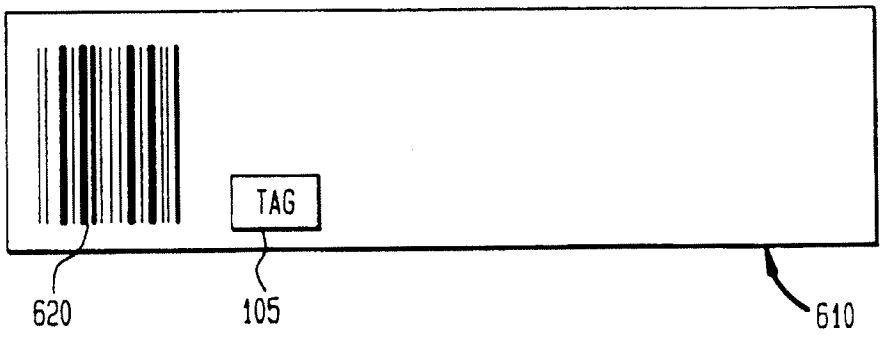


FIG. 7

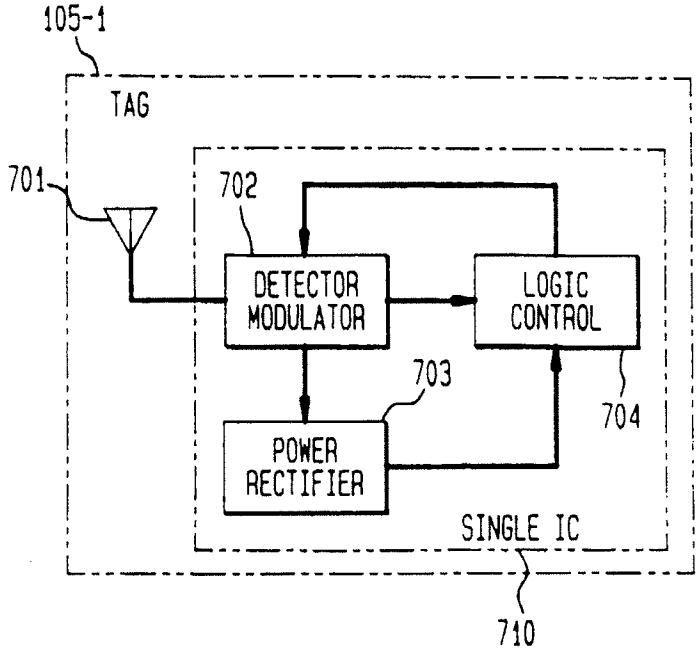

105-1
TAG
701
702
DETECTOR MODULATOR
LOGIC CONTROL
703
704
POWER RECTIFIER
SINGLE IC
710

FIG. 8

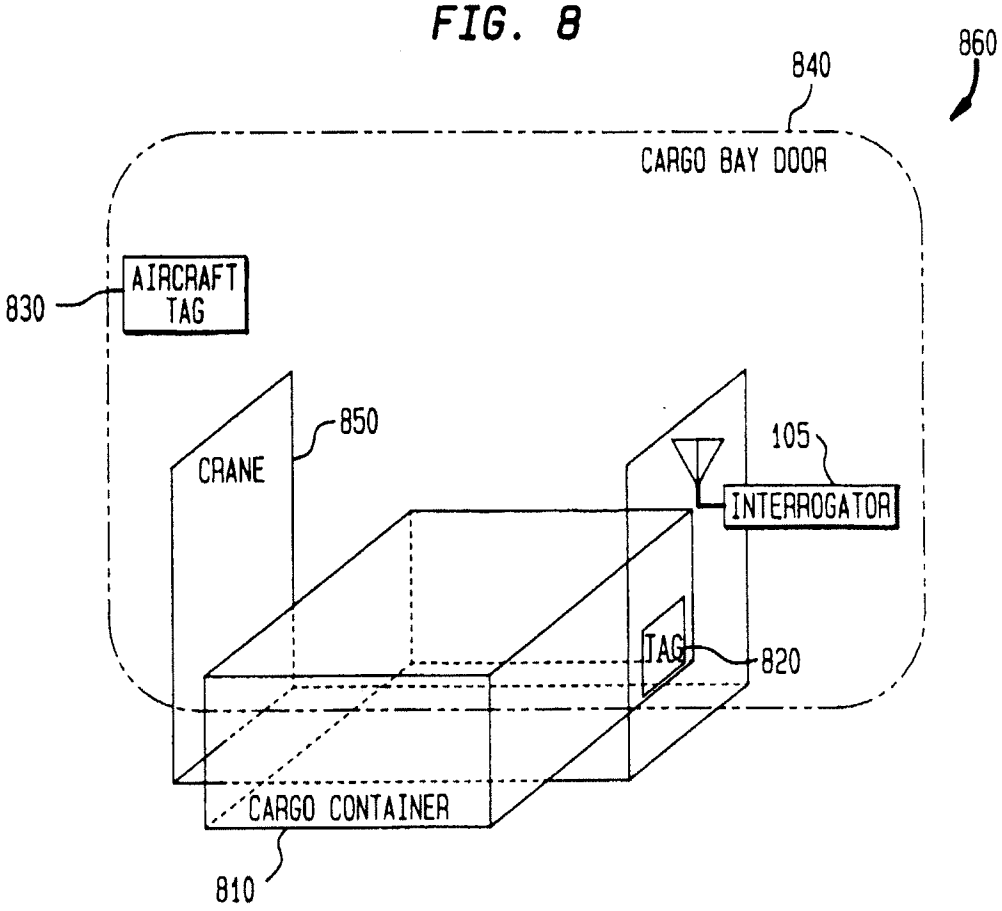
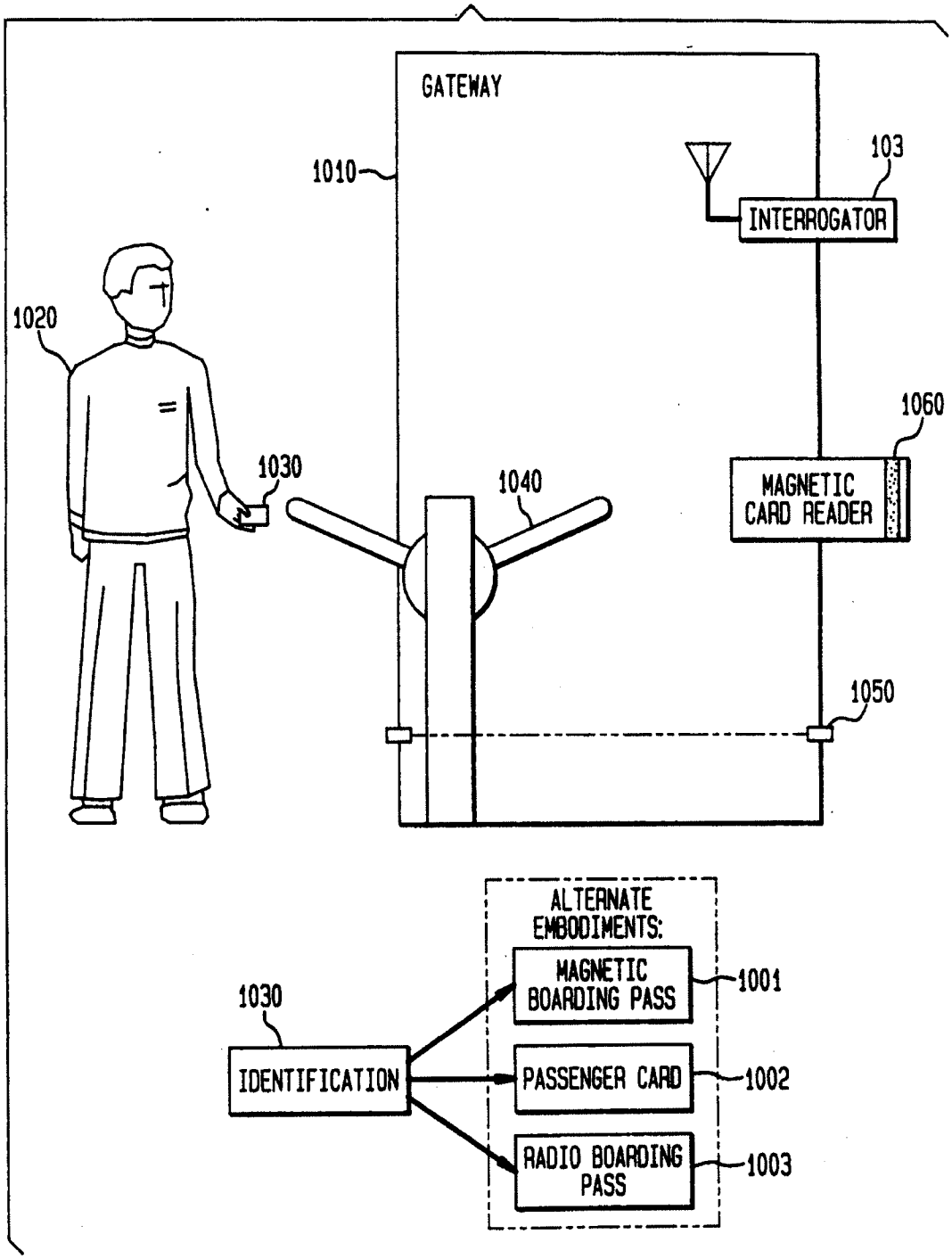

860
840
CARGO BAY DOOR
830
AIRCRAFT TAG
850
CRANE
105
INTERROGATOR
TAG
820
CARGO CONTAINER
810

FIG. 9


GATEWAY
1010
103
INTERROGATOR
1020
1030
1040
1060
MAGNETIC CARD READER
1050
ALTERNATE EMBODIMENTS:
1030
IDENTIFICATION
MAGNETIC BOARDING PASS
1001
PASSENGER CARD
1002
RADIO BOARDING PASS
1003

European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 97 31 0180

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
X	EP 0 670 558 A (AT & T CORP) * the whole document *	1-10	G06K7/00 G06K7/10
A	WO 94 19781 A (NEDAP NV ;KIP HARM JACOB (NL)) * page 12, line 16 - page 14, line 25 *	5	

TECHNICAL FIELDS SEARCHED (Int.Cl.6)

G06K

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	22 April 1998	Degraeve, A

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

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European Patent Office
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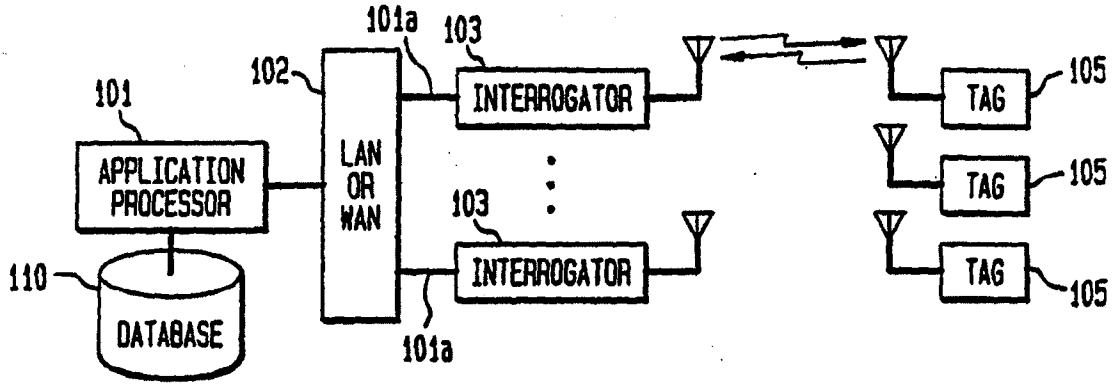
Remarks:
This application was filed on 07 - 04 - 1999 as a divisional application to the application mentioned under INID code 62.

(54) Passsenger, baggage, and cargo reconciliation system

(57) A radio frequency identification system, using modulated backscatter radio communications, is disclosed which supports the automated reconciliation of passengers, baggage, and cargo on a transport. A baggage tag (105) is attached to each piece of checked baggage, where the baggage tag is a read-only tag with modulated backscatter radio capability. Thus, each piece of checked baggage can be identified for sortation, and also identified to ascertain if it has been loaded onto a particular aircraft. Pieces of baggage can be either loaded directly onto an aircraft, or loaded onto a cargo container, where a cargo tag (105) is attached to the cargo container, the cargo tag is a read-write tag with modulated backscatter radio capability. The aircraft itself may be equipped with aircraft tags (105) which could be read-only or read-write tags with modulated backscatter radio capability. Aircraft tags allow a positive association between the identity of the baggage or cargo container being loaded, the aircraft on which it is being loaded, and the cargo bay doorway through which it is being loaded. To identify passengers, several alternatives are disclosed. In one embodiment, a magnetic boarding pass can be used with a magnetic stripe containing information about this passenger. In this embodiment, the passenger is responsible for inserting the magnetic boarding pass into a magnetic card reader as the passenger boards the flight. In another embodiment, a radio boarding pass could be used. The radio boarding pass resembles a conventional boarding pass, however it has read-only modulated backscatter radio capability, perhaps identical with the technology used for the baggage tag. The radio boarding pass can be read as the passenger boards the aircraft. In an alternate embodiment, the passenger can have a passenger card, which is a read-write tag with modulated backscatter capability. The passenger card can be read as the passenger boards the aircraft, to identify the passenger. Alternately, the passenger card can be used for a number of enhanced passenger service applications in a generalized transportation environment.

EP 0 940 763 A1

FIG. 1


101a
103
102
101
INTERROGATOR
TAG
105
APPLICATION PROCESSOR
LAN OR WAN
103
TAG
105
INTERROGATOR
110
TAG
105
DATABASE
101a

Description

Related Applications

[0001] Related subject matter is disclosed in the following applications filed concurrently herewith and assigned to the same Assignee hereof: U.S. patent applications: "Shielding Technology in Modulated Backscatter System," Serial No. 08/777770; "Encryption for Modulated Backscatter Systems," Serial No. 08/777832; "QPSK Modulated Backscatter System," Serial No. 08/775694; "Modulated Backscatter Location System," Serial No. 08/777643; "Antenna Array in An RFID System," Serial No. 08/775271; "Subcarrier Frequency Division Multiplexing of Modulated Backscatter Signals," Serial No. 08/777834; "IQ Combiner Technology in Modulated Backscatter System," Serial No. 08/775695 (now U.S. patent no. 5784686); "In-Building Personal Pager and Identifier," Serial No. 08/775738; "In-Building Modulated Backscatter System," Serial No. 08/775701; and "Inexpensive Modulated Backscatter Reflector," Serial No. 08/774499. Related subject matter is also disclosed in the following applications assigned to the same assignee hereof: U.S. patent application 08/504188, entitled "Modulated Backscatter Communications System Having An Extended Range"; U.S. Patent Application Serial No. 08/492,173, entitled "Dual Mode Modulated Backscatter System,"; U.S. Patent Application Serial No. 08/492,174, entitled "Full Duplex Modulated Backscatter System,"; and U.S. Patent Application Serial No. 08/571,004, entitled "Enhanced Uplink Modulated Backscatter System." Related subject matter is also disclosed in U.S. Patents Nos. 4,711,994, 5,051,565, 5,478,991, and in EP-A-0670558.

Field of the Invention

[0002] This invention relates to communication systems using modulated backscatter technology.

[0003] In the transportation industry, four types of objects are typically transported; passengers, cargo, baggage associated with specific passengers, and cargo not associated with any passengers. To reconcile passengers, cargo, and/or baggage at the start and/or end of transport, it is important to know which passengers are "on board", which cargo and pieces of baggage are on board, and which cargo and pieces of baggage belong to which passengers, if any. Such reconciliation is performed using a passenger, baggage, and cargo reconciliation system. For illustrative purposes of this application, reconciliation systems will be described herein with reference to aircraft as the transportation mechanism.

[0004] Consider a commercial airline flight with passengers, baggage, and cargo on board the aircraft. The passengers board the passenger compartment of the aircraft and the baggage and cargo are stored in the cargo compartments of the aircraft. In larger or containerized aircraft, smaller pieces of baggage or cargo are stored in containers, which are then loaded onto the aircraft. Note that the term "container" includes, but is not limited to, containers and pallets. Smaller aircraft are typically "non-containerized" in the sense that the size of the cargo compartment is insufficient to accommodate the containers used in larger aircraft. Such aircraft are "freeloaded," i.e., each piece of baggage is manually loaded onto and removed from the aircraft. On a freeloaded aircraft, the pieces of baggage are typically transported up a moving ramp from the ground to the doorway of the cargo compartment. Note that some containerized aircraft may have portions of the cargo compartment that are insufficient to accommodate containers. In such containerized aircraft, a combination of freeloading and containerized loading techniques is used.

[0005] Let us consider some of the information the Reconciliation System should include for an aircraft. First, the Reconciliation System should include information regarding the identity of each passenger boarding the aircraft. Clecking in for a flight does not guarantee that a passenger boards the aircraft. It is not uncommon for a passenger to arrive at the airport, check in at the gate and be given a boarding pass, and then fail to board the aircraft; such failure could be caused by the passenger being in the duty free shop, changing his/her mind about traveling, deciding to take a different flight, etc. Furthermore, the number of passengers on board and how those passengers are seated constitutes information used by the flight crew to plan a safe flight.

[0006] Second, the Reconciliation System should also include information regarding the baggage associated with the passengers. The passengers typically checked in their baggage at an airport curb or a check-in station. A baggage tag is usually attached to each piece of baggage, wherein a baggage tag is a paper with printed information, such as the name of the destination city and one or more flight numbers. More recently, a bar code having a "license plate" identification is also printed on the baggage tag, wherein the license plate includes a set of numbers and/or letters that identifies the originating airline and an index number that identifies the corresponding piece of baggage. The license plate is entered in a computer system and is typically associated with the passenger checking-in the baggage and his/her itinerary. The baggage is subsequently sorted and routed to the proper aircraft using the information contained in the baggage tag. Specifically, a baggage handler sorts and routes the baggage to an airport gate by reading the baggage tag manually or with an optical bar code reader. At the gate, assuming a containerized aircraft, the pieces of baggage are loaded onto containers, which are then loaded onto the proper aircraft At the conclusion of the flight, the process is reversed. For a non-containerized aircraft, the pieces of baggage are loaded directly onto the aircraft and, at the conclusion of the flight, the process is reversed.

[0007] Finally, the Reconciliation System should also

include information regarding the cargo to be loaded onto the aircraft. The cargo is sorted and then loaded onto the proper container, assuming a containerized aircraft. The container is then routed to and loaded onto the proper aircraft. At the conclusion of the flight, the process is reversed. For the purpose of this application, discussions involving baggage should be construed to include cargo unless otherwise specified.

[0008] Passenger, Baggage and Cargo Reconciliation Systems of today are unreliable for the following reasons. As mentioned above, a record of a passenger checking in at the gate gives no assurance that the passenger is actually on board the aircraft. A more reliable mechanism to determine which passengers are on board is required. From the baggage perspective, there are several problem areas. First, the bar code on the baggage tag are not a reliable source of information because the baggage tag may wrinkle and fade due to frequent handling, thereby causing a significant percentage of attempts to read bar codes ending in failure. For a piece of baggage that has been through one or two "hops", and has therefore been handled frequently, it is not uncommon for the percentage of bar codes that can be successfully read to be near 50%. Bar codes unsuccessfully read must be manually processed,
therefore adding expense, time and human error. Second, once the bar code is read (either manually or with the optical bar code reader), there is no guarantee that the piece of baggage is actually loaded onto the correct aircraft, or even loaded onto any aircraft. It could be overlooked at the gate, loaded onto the wrong container, or the container could be loaded onto the wrong aircraft. Third, after the piece of baggage is loaded, if the associated passenger does not board the aircraft, it may become necessary to unload that piece of baggage for safety reasons, e.g., prevention of the placement of bombs on an aircraft by a terrorist. In such a situation, the airline either finds the passenger and have that passenger board the aircraft, or the airline unloads the corresponding piece of baggage. Depending on the Reconciliation System used, it may not be easy to determine where in the aircraft a piece of baggage is located. Therefore, valuable time could be lost searching for a particular piece of baggage. On some international flights, this process could delay a flight by as much as two hours.

[0009] There are elements of today's technology which could be of benefit in solving some of the aforementioned problem. The following are some examples. A passenger's boarding pass include a magnetic stripe which identifies that passenger, wherein the magnetic stripe is read into an airline's computer system as that passenger boards the aircraft. Such a system is now being deployed by some airlines. The bar code of the baggage tag could also include information that identifies each piece of baggage in a manner similar to a social security number. This information could be read into the airline's computer system as the baggage is either free-loaded onto the aircraft or the container. Likewise, the container could also be identified with a bar code and read into the airline's computer system as it is loaded onto the aircraft. An association could be made on the airline's computer system to indicate which pieces of baggage are associated with each passenger, and whether the passenger has boarded the aircraft and/or the associated pieces of baggage have been loaded onto the aircraft.

[0010] The above-mentioned solution, however, is costly in terms of staff effort and time -- especially with respect to the baggage and cargo portions of the solution. In the above-mentioned solution, each element of cargo or baggage must be individually and successfully scanned, thereby leading to significant overhead. In addition, the bar codes deteriorate after they have been repeatedly handled making them more difficult to successfully scan.

[0011] One prior art Reconciliation System uses machine readable labels on the passenger's boarding pass and on the baggage tag that supports a computer system performing reconciliation functions. In such a system, the machine readable labels generally store little information, such as information similar to the "license plate" mentioned above. In another prior art Reconciliation System, an identification tag readable with electromagnetic is attached to the baggage tag. This prior art Reconciliation System integrates a specific design of a paper baggage tag with electromagnetic reading capability. In all of these prior art Reconciliation Systems, the passenger and baggage tags are "read-only" and hold relatively little data and rely on a central database to perform the reconciliation functions. Furthermore, the prior art Reconciliation Systems do not provide a direct way to determine the specific container in which a piece of baggage has been loaded. In the event a particular piece of baggage must be removed from the flight, it is imperative that the location (i.e., which container) of the baggage be known.

[0012] Accordingly, there exist a need for a Reconciliation System that has very high reliability in reading data, no manual intervention required to read such data, and the ability to integrate passengers, baggage, cargo, and containers using a single communication infrastructure.

[0013] According to this invention there is provided a communication system as claimed in claim 1.

[0014] The present invention discloses a communication system that includes a radio frequency identification using modulated backscattering. In one embodiment, the communication system is used for the reconciliation of passengers, baggage and cargo on a transport. Specifically, the communication system comprises interrogators for transmitting downlink signals and receiving uplink signals, and tags for receiving the downlink signals and transmitting the uplink signals. The tags are operable to demodulate a first information signal from a downlink signal and generate a second information sig-

nal having a data rate f, wherein the contents and data rate f of the second information signal depends on the contents of the first information signal. Subsequently, the second information signal and a subcarrier signal is used to generate an output signal, which is used to modulate backscatter the downlink signal.

[0015] In one embodiment, the tag includes a modulator that generates an output signal by modulating the second information signal onto the subcarrier signal if the second information signal is not a single bit message. If the second information signal is a single bit message, the modulator generates an output signal that is an unmodulated subcarrier signal. In another embodiment of the present invention, the interrogators include a narrowband filter for filtering noise from the uplink signals.

[0016] In one embodiment, the downlink signal includes an interrogation signal which instructs one or more tags receiving the downlink signal to transmit an uplink signal which includes data stored in a memory of the tag. In another embodiment of the invention, the downlink signal includes a tag address and a location signal which instructs the tag corresponding to the tag address to transmit an uplink signal that can be used to locate the tag. In another embodiment, the downlink signal includes a tag address and data which is to be stored in the tag corresponding to the tag address.

Brief Description of the Drawing

[0017] The features, aspects, and advantages of the present invention will become better understood with regard to the following description, appended claims, and accompanying drawings where:

FIG. 1 shows a block diagram of an illustrative Radio Frequency Identification (RFID) system;

FIG. 2 shows a block diagram of an illustrative Interrogator Unit used in the RFID system of FIG. 1;

FIG. 3 shows a block diagram of a Tag Unit used in the RFID system of FIG. 1;

FIG. 4 shows the relationships among the Interrogation, Location Mode, and Messaging Mode Ranges;

FIG. 5 shows the relationships among the Uplink Range for the Interrogation, the Uplink Range for the Messaging Modes, and the downlink Range for all three Modes;

FIG. 6 shows a Radio baggage tag;

FIG. 7 shows a block diagram of the electronics of the Radio baggage tag of FIG. 6;

FIG. 8 shows how a Cargo Container, with an attached Container Tag, is identified and loaded onto an Aircraft; and

FIG. 9 shows a Passenger entering a Gateway that leads to an aircraft, and how the Passenger is identified.

Detailed Description

[0018] The present invention may be embodied in a Reconciliation System having a Radio Frequency Identification (RFID) system using Modulated Backscatter (MBS). In one embodiment of the present invention, the Reconciliation System utilizes Tags that are capable of transmitting data at various data rates, wherein the slower data rates extend the range of the Reconciliation System, as will be described herein.

RFID Systems

[0019] Radio Frequency Identification (RFID) systems are used for identification and/or tracking of equipment, inventory, or living things. RFID systems are radio communication systems that communicate between a radio transceiver, called an Interrogator, and a number of inexpensive devices called Tags. In RFID systems, the Interrogator communicates to the Tags using modulated radio signals, and the Tags respond with modulated radio signals. Specifically, the Interrogator transmits an amplitude modulated signal to the Tag, and then transmits a Continuous-Wave (CW) radio signal to the Tag. The Tag modulates the CW radio signal using Modulated BackScattering (MBS) where the antenna is electrically switched, by a Tag's modulating signal, from being an absorber of RF radiation to being a reflector of RF radiation, thereby encoding a Tag's information onto the CW radio signal being reflected. The Interrogator demodulates the incoming CW modulated radio signal and decodes the Tag's information.

MBS Operation

[0020] Referring to FIG. 1, there is shown an overall block diagram of a Radio Frequency Identification (RFID) system in accordance with one embodiment of the present invention. As shown in FIG.1, an Application Processor 101 communicates over a Local Area Network (LAN) or Wide Area Network (WAN) 102 to a plurality of Interrogators 103 which, in turn, communicate with one or more Tags 105. Referring to FIG. 2, there is shown a block diagram of an illustrative Interrogator 103 As shown in FIG. 2, a processor 200 receives an Information Signal 101a from the LAN 102. The processor 200 subsequently formats the Information Signal 101a into an Information Signal 200a. A Modulator 202 modulates the Information Signal 200a onto a Radio Signal 201a (also referred to herein as a "carrier signal") generated by a Radio Signal Source 201, thereby creating a First Modulated Signal 202a (also referred to herein as a "Modulated Carrier Signal") which is then transmitted by a Transmitter 203 via Antenna 204. Upon transmission of the First Modulated Signal 202a, the Interrogator 103 then transmits a continuous wave (CW) radio signal. Transmission from the Interrogator is referred to herein as a Downlink. Thus, the transmitted First Mod-

ulated Signal and CW radio signal constitutes a Downlink Signal 204a.

[0021] In one embodiment, the First Modulated Signal 202a is transmitted using amplitude modulation. In this embodiment, amplitude modulation is chosen because amplitude modulated signals can be demodulated by the Tag with a single inexpensive nonlinear device such as a diode.

[0022] Referring to FIG. 3, there is shown a block diagram of an illustrative Tag 105. As shown in FIG. 3, the Tag 105 includes an Antenna 301, such as a loop or patch antenna, for receiving the Downlink Signal 204a transmitted by the Interrogator 103. The First Modulated Signal of the Downlink Signal 204a is demodulated, directly to baseband, using a Detector/Modulator 302 -- that is, the resulting demodulated signal 302a is essentially the Information Signal 200a. In one embodiment, the Detector/Modulator 302 is a microwave diode, such as the well-known Schottky diode. To minimize signal loss of the First Modulated Signal, the Detector/Modulator 302 should be appropriately biased with the proper current level in order to match the impedance of the Antenna 301 to the Detector/Modulator 302.

[0023] The Demodulated Signal 302a is then amplified by an Amplifier 303 and synchronization recovered in a Clock and Frame Recovery Circuit 304. The resulting Recovered Signal 304a is sent to a Processor 305, where the Recovered Signal 304a is analyzed - that is, the Processor 305 examines the content of the Information Signal 200a. Note that the Processor 312 includes a crystal oscillator 312 for providing timing information. In one embodiment, the Processor 305 is typically an inexpensive 4- or 8-bit microprocessor, and the Clock and Frame Recovery Circuit 304 is implemented in an ASIC (Applied Specific Integrated Circuit) which cooperates with the Processor 305. For purposes of this application, the term processor includes, but is not limited to, processors, micro-processors, and ASICs.

[0024] Depending on the content of the Information Signal 200a, the Processor 305 then generates another Information Signal 306 to be sent from the Tag 105 back to the Interrogator 103. The Information Signal 306 is provided as input to a Modulator Control Circuit 307, which uses the Information Signal 306 to modulate a Subcarrier Signal 308a generated by a Frequency Source 308. In one embodiment, the Frequency Source 308 is derived from the crystal oscillator 312, or is a crystal oscillator separate from the Processor 305. In another embodiment, the frequency source is derived from signals present inside the Processor 305 -- such as a divisor of the primary clock frequency of the Processor.

[0025] The Modulated Control Circuit 307 outputs a Modulated Subcarrier Signal 311, which is used by the Detector/Modulator 302 to modulate the CW radio signal of the Downlink Signal 202a, thereby producing a Modulated Backscatter (e.g., reflected) Signal 301a. Note that transmission from the Tag to the Interrogator is referred to herein as an Uplink. Thus, the Modulated Backscatter Signal constitutes an Uplink Signal.

[0026] In one embodiment, the presence of the Modulated Subcarrier Signal 311 (or lack thereof) causes the Detector/Modulator 302, e.g., Schottky diode, to change the reflectance, i.e., impedance, of the Antenna 301 -- for example, the impedance of the antenna is changed from zero to infinity.

[0027] Power is provided to the circuitry of the Tag by a power source 310. For purposes of this application, the term "power source" includes, but is not limited to, batteries and devices operable to transform microwave or magnetic energy into electrical energy, such as rectifiers and inductive couplings.

[0028] It has been found that considerable advantages are present to an MBS design that uses a single frequency subcarrier. Many modulation schemes are possible. These modulation schemes include, but are not limited to, Phase Shift Keying (PSK) of the subcarrier (e.g., BPSK, QPSK) and more complex modulation schemes (e.g., MSK, GMSK).

[0029] Referring back to FIG. 2, the Interrogator 103 receives the Uplink Signal 301a with a Receive Antenna 206, amplifies the Uplink Signal 301a with a Low Noise Amplifier 207, thereby obtaining an Amplified Signal 207a. The Amplified Signal 207a is provided as input to a Mixer 208, which uses homodyne detection to demodulate the Amplified Signal 207a down to the intermediate frequency (IF) corresponding to the subcarrier signal 308a (frequency f_s) -- that is, the Radio Signal 201a is used to demodulate the Amplified Signal 207a to obtain a Demodulated Signal 209, which is essentially the Modulated Subcarrier Signal 311. Note that such homodyne detection has advantages in that it greatly reduces phase noise in the receiver circuits. Subsequently, the Mixer 208 sends the Demodulated Signal 209 into a Filter/Amplifier 210 where the Demodulated Signal 209 is filtered. The resulting Filtered Signal 211 is then demodulated in a Subcarrier Demodulator 212 to obtain an Information Signal 213, which is essentially the Information Signal 306. The Information Signal 213 is provided as input to a Processor 200 to determine the content of the Information Signal 213. Note that if the Mixer 208 is a Quadrature Mixer, the Mixer 208 will send both I (in phase) and Q (quadrature) signals. In such a case, the I and Q channels of Demodulated Signal 209 can be combined in the Filter/Amplifier 210, in the Subcarrier Demodulator 212, or in the Processor 200.

[0030] In an alternate embodiment of the present invention, the Interrogator includes a single antenna for transmitting and receiving radio signals. In this embodiment, an electronic method of separating the transmitted signal from that received by the receiver chain is needed. This could be accomplished by a device such as a Circulator, which is well-known in the art.

[0031] The present invention includes several implementations of the Subcarrier Demodulator 212. These implementations include, but are not limited to, conventional analog I/Q demodulation of the subcarrier signal

using, e.g., a Costas Loop, Digital Signal Processing (DSP) of the sampled subcarrier, or implementing a receiver in digital logic. Since minimizing the system cost is one objective, one embodiment of the present invention implements the Subcarrier Demodulator in digital logic.

Range Extension

[0032] The performance of the present invention can be enhanced by extending the range of the RFID system. Essentially, this involves extending the ranges of the Downlink and the Uplink. Extending the range of the Downlink involves several factors. First, the range of the Downlink can be extended by minimizing signal loss. As mentioned earlier, in one embodiment, the Downlink is an amplitude modulated signal which is easily and inexpensively detected by a Detector/Modulator that is a single nonlinear device, such as a microwave or Schottky diode. To minimize signal loss from the antenna 301 to the nonlinear Detector/Modulator, it is important to match the impedance from the antenna to the diode. Second, the data rate of the Downlink can be limited to reduce the noise bandwidth of the Downlink signaL Third, the Antenna 301 of the Tag can be used to filter out RF signals outside of the antenna bandwidth (in additional to receiving RF signals). For example, at 2.45 GHz, allowable RF carrier frequencies are from 2.400 - 2.485 GHz. The design of the antenna, such as a patch antenna, covers this frequency band but filters out frequencies beyond this range. An ideal frequency response would be for antenna sensitivity to be within 3 dB across the allowable frequency range, but to fall off rapidly beyond this range. Furthermore, the Amplifier 303 can also act as a filter in the sense that the Amplifier can be designed to only pass signals that are within a certain passband around the expected Downlink data rate, which typically ranges from a few kilobits per second up to tens of kilobits per second. The above-described Tag design is not greatly sensitive to RF transmissions inside the frequency band of the antenna, whose modulation scheme is primarily a constant envelope. Thus, such Tag design allows a robust Tag which is resistant to many potential interfering signals.

[0033] Extending the range of the Uplink also involves several factors. First, the noise bandwidth of the Uplink signal could be reduced by decreasing the data rate as much as possible. The number of useful applications that can be implemented is not limited if the data rate of the Uplink signal is limited to a few bits per second. The limitation of the data rate can be taken to the extreme in which there is no data modulated onto the single subcarrier frequency. In such a case, the mere presence or absence of a signal received at this subcarrier frequency can indicate an "acknowledgment" or "no acknowledgment" to a previous message. Second, the range of the Uplink can be extended using narrowband filtering of a subcarrier signal, wherein the subcarrier signal can be relatively accurately determined. In one embodiment, the frequency source 308 generates a subcarrier signal with a relatively accurate frequency. For example, the Frequency Source 308 can be a commercially available and inexpensive crystal oscillator with a frequency of 32kHz, and an accuracy of ± 100 ppm -- that is, the frequency of the crystal oscillator is known to within ± 3.2 Hz. In one embodiment, narrowband filtering is implemented in the Interrogator using a processor 210a, such as a digital signal processor (DSP), that performs the functions of the Filter Amplifier 210 and the Subcarrier Demodulator 217. In this embodiment, the processor 210a uses narrowband filtering algorithms, which are well-known in the art, to perform digital filtering of the signal with a bandwidth of less than 10 Hz, and first sidelobes that are depressed 60 dB. Then, the signal strength of the signal received through this digital signal processor 210a is measured, and that strength is compared to a reference signal strength which is sufficiently above the average noise in that channel when no signal is present such that spurious noise spikes are not misinterpreted as actual signals. In this manner, very weak Uplink signals can be reliably detected. It has been found that, using these techniques, roughly equivalent range in the Downlink and the Uplink can be achieved.

[0034] We now discuss the location of the subcarrier frequency f_ss. MBS systems exhibit noise in the Uplink signals due to reflections of the RF source from any number of reflectors. There are typically two categories of reflectors: reflectors that reflect signals at the same carrier frequency at which the signal was transmitted, and reflectors that reflect signals at frequencies away from the carrier frequency at which the signal was transmitted. The former category includes walls and metal objects. Signals reflected from these reflectors have an arbitrary phase relationship with respect to the carrier signal. To cancel the reflections, a Quadrature Mixer 208 operating as a Homodyne Detector is used. The latter category of reflectors generates reflected noise at frequencies away from the main carrier frequency -- either from Doppler shifts (caused by moving metallic objects) or from reflections off of electronic equipment operating at frequencies near the Subcarrier Frequency. One particularly difficult source of noise is fluorescent lights, which have been shown to produce noise not only at their fundamental 60 Hz (in the United States) frequency, but also at overtone frequencies well up into the tens of thousands of Hertz. It has been found especially helpful to locate the subcarrier frequency f, such that it falls between multiples of the fundamental 60 Hz frequency. In one embodiment, a 32 kHz crystal oscillator is used to generate a subcarrier frequency that meets this requirement.

Multiple Mode Operation

[0035] In one embodiment, the Reconciliation System is capable of multi-mode operation. In this embodiment,

the Tags and Interrogator are operable to transmit data at a high data rate and a low data rate. Note that other data rate modes are also possible, and the present invention should not be construed to be limited to the two aforementioned data rates. In one embodiment of the present invention, actual data messages, e.g., multi-bit or high bit messages, are transmitted and received by the Reconciliation System using the high data rate mode, and acknowledgment messages, e.g., single or low bit messages, are transmitted and received by the Reconciliation System using the low data rate mode.

[0036] Advantageously, the low data rate mode provides the Reconciliation System of the present invention with enhanced range. As discussed earlier, the low bit rate mode is used to transmit the acknowledgment messages which are typically one bit or relatively low bits. Because of this fact, the acknowledgment messages could be transmitted over smaller frequency bands than actual data messages. Smaller frequency bands permit the application of narrowband filtering of noise outside the frequency band, thereby enhancing the range the acknowledgment message could be transmitted.

[0037] As discussed above, to send a single bit of information, the Tag could generate an unmodulated subcarrier frequency which could be modulated onto the incident signal, i.e., reflected continuous wave radio signal, using modulated backscatter. The Interrogator would then receive a reflected signal with a single frequency tone. Narrowband filtering techniques could then be used to reduce the noise bandwidth and determine the presence or absence of this signal.

[0038] In operation, the Tag 105 detects and assembles the bits of information sent from the Interrogator 103 as a Downlink message. Typically, a pattern of synchronization bits is transmitted at the beginning of the Downlink message. These bits allow the Tag to acquire bit and message synchronization, thereby enabling the Tag to determine the beginning and the end of the Downlink message. In one embodiment, the Downlink message includes an Address, a Command, and perhaps Data and Error Detect and/or Correct. The Command or Data portion of the Downlink message should indicate whether the Tag 105 is to return an actual data message, such as a Tag ID or other application-specific data, or an acknowledgment message, such as a single-bit acknowledgment message.

[0039] The Processor 305 of the Tag 105 determines what type of Uplink signal is to be transmitted back to the Interrogator. There are several ways that the Tag 105 may transmit either an actual data message or an acknowledgment message so that the Interrogator 103 can receive and distinguish between these two different types of messages. Referring back to FIG. 3, in one embodiment, the Information Signal 306 is transmitted from the Processor 305 to the Modulator Control 307 over a lead 306a. In the event that Processor 305 of Tag 105 is to send a "single tone" message consisting of a single information bit, the lead 306a is maintained in a first logic state to indicate that no information message is to be sent, thereby causing the Modulator Control 307 to output an unmodulated subcarrier signal 311. In the event that Processor 305 determines that an actual data message is to be sent, the lead 306a conveys the actual data message to the Modulator Control 307. This actual data message is then used to modulate the subcarrier signal 308a using one of several possible modulation techniques, such as amplitude, phase, frequency, or code modulation.

[0040] Referring back to FIG. 2, the Interrogator 103 receives and demodulates the modulated (or unmodulated) subcarrier signal from the received Uplink signal, and then applies filtering. Given the specifics of the subcarrier frequency, a suitable filtering amplifier 210 is utilized to filter out noise. Subcarrier Demodulator 212 then demodulates the Information Signal 306, if any, from the modulated (or unmodulated) subcarrier signal. The Processor 200 then performs the digital signal processing necessary to decode the information signal 306. In one embodiment of this invention, the Processor 200 may be a Digital Signal Processor (DSP). In other embodiments, a conventional Microprocessor could be used as the Processor 200.

[0041] To recover a "single tone" acknowledgment message having a single subcarrier tone, the filtering amplifier should be a narrowband filter. While conventional filter technologies could be used, it may be most effective to utilize the DSP 210a mentioned above as a narrowband filter. The subcarrier frequency of this single tone is well known since the Tag 105, in one embodiment, would typically use an inexpensive crystal as the frequency source. Even with the limited accuracy of that crystal, the subcarrier frequency could be known to an accuracy of a few Hertz, therefore allowing very narrowband filtering. Since the acknowledgment message response from Tag 105 is used to extend the range of the RFID system and consequently would likely be a very faint signal, it places an additional burden on the narrowband filter of filtering amplifier 210.

[0042] Another way that the DSP mentioned above could be used is to dynamically search for the frequency components of the Uplink signaL This could be accomplished by performing a Fourier Transform on the incoming data stream, in one embodiment, using the Processor 200 of FIG. 2. In this embodiment, the multiple signals representing a modulated subcarrier signal could be differentiated or a single subcarrier signal of uncertain data rate could be recovered using the Fourier Transform to search for multiple signals.

[0043] Thus, we have shown how a modulated backscatter communication system can operate in two modes --one in which the backscattered signal is modulated to provide a high data rate Uplink communication channel, and one in which the backscattered channel is modulated with a low data rate signal, perhaps a single tone, to provide an Uplink acknowledgement signal that can be detected at great distances.

Multi-Mode Implementation

[0044] In one embodiment, the multi-mode operation of the present invention Reconciliation System is implemented into three services. The first service to be discussed is referred to herein as "Interrogation" service. Interrogation begins with the Interrogator transmitting a Downlink referred to herein as an Interrogation Signal to the Tag. The Tag decodes the received Interrogation Signal and determines what actions to take based upon the decoded Interrogation Signal. In a "standard" Interrogation, the Tag would be requested to transmit a set of data referred to herein as Mandatory Data back to the Interrogator using MBS. Each Tag in a reading field of an Interrogator that receives the "standard" Interrogation responds with its Mandatory Data, using a protocol discussed herein. Note that the term "reading field" is defined as the area of space within which the Tag and the Interrogator can communicate. The Interrogator also transmits, as part of the "standard" Interrogation service, data intended for each and all Tags. Examples of such data include time of day, framing and other synchronization information, etc. In one embodiment, the Mandatory Data includes identification information

[0045] Beyond the "standard" Interrogation, other types of Interrogations are possible as well. For example, the Interrogator, after identifying a specific Tag using the Interrogation, could transmit additional data to that Tag to be stored in the Tag's memory. The Interrogator could also request the Tag transmit other data, stored in the Tag's memory, back to the Interrogator. These additional data communications could be performed at the same data rate used in the "standard" Interrogation. Thus, Interrogation could be used to transmit commands and data to each and every Tag, to identify a specific Tag in the reading field, and to communicate bi-directionally with a specific Tag. In Interrogation, the data rate required in the Downlink is typically not large, since the Interrogation Signal only must contain enough bits to request all Tags in the reading field to respond. In the Uplink, the amount of data is typically much larger than the amount of data in the Downlink. Since the Mandatory Data must frequently be transmitted in the Uplink in a time critical manner, the data rate should therefore be much higher in the Uplink than the Downlink -- that is, there exist asymmetry in data rates between the Uplink and Downlink in the sense that the Downlink data rate is smaller than the Uplink data rate.

[0046] The second service is referred to herein as "Location." The Location service is used by the Reconciliation System to locate the position of a Tag. In Location, the Interrogator transmits a Downlink referred to herein as a Location Signal to the Tag containing the address of a specific Tag to which the Location Signal is directed. In this source, the Tag is requested to respond, one embodiment, with a simple acknowledgment message, such as a constant tone signal. Using the narrowband techniques discussed above, a constant tone signal can be received by the Interrogator at a range far beyond the range of the Interrogation service. Therefore, in the Location service, there exist an asymmetric communications path where the Downlink has a greater data rate than the Uplink.

[0047] In one embodiment, the Location service is used to determine the location of a specific Tag 105 as follows. Let us assume that the Reconciliation System currently has no information as to the location of a Tag. The Interrogators of the Reconciliation System transmit Location Signals and then listen for possible responses, i.e., acknowledgement messages. In one embodiment, each Interrogator is operable to determine the signal strength of the received response (if any) and reports their determination to a location process residing on the LAN 102 or Application Processor 101, wherein the location process is a software process operable to determine the location of a Tag based on the signal strength of the acknowledgment messages being reported to the location process by the Interrogators. In one embodiment, the location process determines the location of the Tag is equal to the location of the Interrogator receiving the strongest acknowledgment message signal strength, wherein the accuracy of the Tag's location is the effective range of that Interrogator. In another embodiment, the location process utilizes a more complex method to determine a Tag's location if more than one Interrogator received an acknowledgment message. In this embodiment, the location of the Tag can be determined based on which Interrogator received an acknowledgement message and the spatial position of each Interrogator. For example, if two Interrogators received an acknowledgment message of equal signal strengths, then the Tag's position could be estimated at half way between those two Interrogations. If three Interrogators received an acknowledgment message, then a "triangulation" could be performed. See "The NLOS Problem in Mobile Location Estimation Proceeding 1996 5th International Conference on Universal Personal Communic. Oct 96" by Marilynn Wyle and Jack Holtman.

[0048] The third service is referred to herein as "Messaging." In Messaging, a Downlink referred to herein as a Messaging Signal containing the address of one or more Tags and data intended for those Tags is transmitted by the Interrogators. The Tag or Tags whose address matches the Tag address or addresses in the Messaging Signal could be instructed to store that data in a memory associated with the Processor 305, such as memory 305a, or perform some other function with that data. There appropriate Tags could respond to the Messaging Signal in one of several manners. If the Messaging Signal instructs the Tag to store the data, the Tag acknowledges receipt of the Messaging Signal by returning an acknowledgment message to the Interrogator. Alternatively, if the Messaging Signal instructs the Tag to make a decision, or to transmit other data back to the Interrogator, then the response could be an ac-

knowledgment message with a few bits of data. Thus, in Messaging, there exist an asymmetric communications path where the Downlink has a greater data rate than the Uplink if the Uplink is an acknowledgment message. If the Uplink is an actual data message, there will typically exist an asymmetric communications path where the Downlink has a smaller data rate than the Uplink.

[0049] In an alternate embodiment, it is possible for a communication to begin in one of the above services and change into another service. The following is an illustration of such a possible communication. Assume communication with a Tag is desired. A Messaging Signal is transmitted from the Interrogator to the Tag instructing the Tag to respond with a simple acknowledgment, which is received by the Interrogator. Further assume that, based upon the acknowledgment message received by the Interrogator, the Interrogator wishes to instruct the Tag to transmit additional data back to the Interrogator. For example, the Interrogator determines the signal strength of the acknowledgment message and, if the signal strength is below a certain threshold, limits the Uplink data rate to the data rate normally used in the Uplink for the Messaging service. Otherwise the signal strength is above a certain threshold and the Interrogator changes the Uplink data rate to the data rate normally used in the Uplink for the Interrogation service. It should be understood that, while the above example showed how the Uplink communications could take place at either one of two possible Uplink data rates, other Uplink data rates are possible.

[0050] In one embodiment of the present invention, all three services discussed above can coexist in the same system and be operational at the same time. We begin with the realization that these services, based upon the required data rates, support different ranges from the Interrogator to the Tag. For example, the Interrogation service involves significant data transmission over (relatively) short time periods, such as when a Tag moves by an Interrogator. The required data rate is further increased if there are several Tags in the reading field at one time. When there are multiple Tags transmitting data simultaneously, a protocol is required to allow multiple Uplinks without mutually interference. In one embodiment, the protocol used is Aloha or Slotted Aloha. Typical data rate for the Interrogation service range from 50 kbps - 300 kbps. Note that, in the absence of other factors, range and data rate trade off against each other. See "Queuing Systems Vol. 2 Computer Applications" by Leonard Kleinrock, published by John Wiley & Sons, NY in 1976.

[0051] In summary, there exist two different "asymmetries" in data rates: greater data rates for Uplink than Downlink in the Interrogaton service, and greater data rates for Downlink than Uplink in the Location and Messaging services. Thus, the effective range for the Interrogation service is smaller than that of the Location or Messaging services because the Uplink data rate requirement is greater in the Interrogation service. This difference in ranges is illustrated in FIG. 4. It is important to observe the relationships between these data rates. In the "Range Extension" section above, it was disclosed how to achieve significant range extension using, among other techniques, narrowband filtering. In one embodiment, the Location and Messaging services roughly have a Downlink data rate of a few kilobits per second and an Uplink data rate of a few bits per second. The Interrogation service has roughly a Downlink data rate of a few kilobits per second and an Uplink data rate of 50 kbps - 300 kbps.

[0052] Referring to FIG. 5, there is shown an illustration of the relationship between the ranges for these three services. As shown in FIG. 5, the Downlink range 503 is the same for all three services. The Uplink range 502 for the Location and Messaging services is roughly the same as the Downlink range 503. By contrast, the Uplink range 501 for the Interrogation service is much smaller than the Uplink range 502.

[0053] Note that the above discussion ignores the effects of directional antennas. In some Interrogation applications, it is appropriate to use directional antennas to increase effective range, and to form a "reading field" whose shape and size is optimized to that application. The above discussion has been general, and implicitly assumes that all three services use the same antenna technology. The use of different antenna patterns will be discussed herein.

RFID System Architecture

[0054] At this point, the placement of the Interrogators will now be discussed. Referring back to FIG. 1, the Application Processor 101 is operable to support a Database 110 that stores information regarding passenger, baggage and cargo. For example, the Database 110 includes information about the identity of the passengers on board an aircraft, the passengers' associated baggage, the location of the baggage, etc. In one embodiment, the Interrogators are distributed throughout the airport complex. For purposes of discussion, it is assumed that the coverage throughout the airport complex for the Interrogation service is not complete, i.e., the Interrogation service is only available in certain well defined areas of the airport complex. This assumption is justified since the Interrogation service is generally used to identify Tags as they pass by a specific location (such as a doorway, etc.) It is further assumed that for the Location and the Messaging services, the coverage of the airport complex is greater than the coverage for the Interrogation service. Ideally, it is desirable to provide Location and Messaging services to anyone in the airport complex.

[0055] For the Location or Messaging services, one embodiment of the present invention would be to place enough Interrogators in the airport complex such that any point in the airport complex is within the range of at

least three Interrogators, thereby permitting the implementation of a Location service using triangulation of the received Uplink signal strength. In another embodiment, the Interrogators are placed in a "partially overlapping" fashion, such that any point in the airport complex is within the radio coverage area of at least one Interrogator. Given this configuration, a relatively simple Location service can be implemented, with the accuracy of the Location service comparable to the coverage area of one Interrogator.

Baggage and Cargo Identification

[0056] At this point, the distribution of the Tags will now be discussed. To support automated identification, one embodiment includes three types of Tags 105; a Radio baggage tag, a Container Tag, and an Aircraft Tag. These automated identification means supplement or replace methods in operation today, which includes manual sortation of optical bar codes.

Radio baggage tag

[0057] Referring to FIG. 6, there is shown a Radio baggage tag 610 in accordance with one embodiment of the present invention. As shown in FIG. 6, the Radio baggage tag 610 includes a Tag 105 which may have a luggage identification, a passenger identification, routing information, etc. Note that the Radio baggage tag 610 may also include a Bar Code License Plate 620 to provide routing and other information in airports where the Reconciliation System of the present invention is not available. To reduce the cost of the Radio baggage tag 610, several components of the Tag 105 may be eliminated. Referring to FIG. 7, there is shown a block diagram of a Tag 105-1 in accordance with one embodiment of the Radio baggage tag 610. As shown in FIG. 7, the Tag 105-1 includes an Antenna 701 and a single Integrated Circuit (IC) 710, which includes a Detector/Modulator 702, a Logic Control 704 and a Power Rectifier 703. In this embodiment, the Radio baggage tag 610 is a read-only Tag, and not a read-write Tag - that is, the Tag 105-1 is only capable of responding to an Interrogation Signal, and the response provided to the Interrogation Signal is fixed, i.e., the Tag is "write once, read many."

[0058] The Tag 105 illustratively shown in FIG. 3 has been greatly simplified to arrive at the Tag 105-1 of FIG. 7. The Antenna 701 receives the incoming RF signal and power is supplied to the circuitry of the Tag 105-1 by the Power Rectifier 703, i.e., the Power Rectifier rectifies the incoming RF signal. The range at which the Radio baggage tag 610 can be powered is then the controlling factor in both the Downlink and the Uplink range. In one embodiment, the maximum range of the Tag 105-1 is two meters. Furthermore, since the Tag 105 is read-only (and not read-write), there is no need for a Processor as sophisticated as a 4 or 8 bit microprocessor, and custom logic, such as the Logic Control 704 can be substituted. Still further, since the data is written once and read many times, the Tag does not need an expensive on-chip re-writeable storage - that is, inexpensive fuses contained within the Logic Control 704 can be used. The Logic Control 704, upon detection of an incoming RF signal, then activates the Detector Modulator 702 to perform the modulated backscatter communications disclosed above. The Tag 105-1 of FIG. 3 can therefore be reduced to a Single IC 710 with an Antenna 701. Note that the Radio baggage tag 105-1 could also be used for the Location service. Further note that the initialization of the Radio baggage tag 610 includes writing into memory the data desired to be retrieved in the Interrogation service, e.g., associated passenger, identification number, etc. This initialization could be done during or after the process to print the Bar Code License Plate 620 onto the Radio baggage tag 610.

Container Tag

[0059] In one embodiment, the Container Tag is a read-write Tag 105. Preferably, the Container Tag is packaged in a rugged packaging, due to the environmental stresses placed upon it. Referring to FIG. 8, there is shown a Container 810 with a Container Tag 820 being loaded onto an aircraft via a cargo bay door 840. In one embodiment, the Container Tag 820 is operable to respond to Interrogation, Messaging, and Location services. The Container Tag 820 is designed to be affixed to the Cargo Container 810 (which could be a container or a pallet), so that the Cargo Container 810 can be identified as it passes though an entrance or egress to a cargo handling facility, and aircraft, etc., where an Interrogator will be typically positioned.

[0060] Because the Container Tag 820 has read-write capabilities, the Container Tag 820 may be used to store helpful data. For example, assume that pieces of baggage containing Radio baggage tags 610 are loaded into a Container 810 equipped with a Container Tag 820. The identification data can be read from the Radio baggage tag 610 by the Interrogator using the Interrogation service. Such identification data can be subsequently transmitted to and stored in the Container Tag 820 using the Messaging service. Thus, data concerning the contents of the Container 810 would be available though the Container Tag 820. Also note that the Container Tag could also be used in the Location service to locate misplaced, lost or stolen containers. This could be of benefit in an airport environment, since it may happen for one airline to barrow a Container 810 from another airline, and not inform the other airline of the borrow.

Aircraft Tag

[0061] Aircraft Tags of the present invention can be used to determine whether baggage, cargo and/or containers have been loaded onto a particular aircraft. In

one embodiment, the Aircraft Tag is a function equivalent to the Tag 105 of FIG. 3 -- that is, the Aircraft Tag has read-write capabilities. Referring back to FIG. 8, a Container 810 is loaded onto an Aircraft 860 by the use of a Crane 850. Mounted onto the Aircraft 860 at or near the Cargo Bay Door 840 is an Aircraft Tag 830. In one embodiment, the Aircraft Tag 830 has Mandatory Data that identifies the Aircraft 860 and the Cargo Bay Door 840 being used. In operation, the Interrogator 105 on top of the Crane 850 could read the Aircraft Tag 830, thereby allowing the Reconciliation System to know the identity of the Aircraft 860 on which baggage, cargo and containers are being loaded and the identity of the Cargo Bay Door 840 being used. Thus, associations between the Aircraft 860, the Cargo Bay Door 840, the Radio baggage tag 610, and the Container Tag 820 can be made.

Passenger Identification

[0062] Referring to FIG. 9, there is shown a Passenger 1020 entering a Gateway 1010 to board an aircraft. The Passenger 1020 has an Identification means 1030. The Identification means 1030 can be, but is not limited to, a Boarding Pass 1001, a Radio Boarding Pass 1003, or a Passenger Card 1002.

Magnetic Boarding Pass

[0063] The Magnetic Boarding Pass 1001 is a device, in one embodiment the size of an airline ticket, with an attached magnetic stripe. The information on the Magnetic Boarding Pass 1001 can include the identification of the passenger, the flight number and seat number of this passenger, and other such data. When the Passenger 1020 enters the Gateway 1010, the Passenger must insert the Magnetic Boarding Pass 1001 into a Magnetic Card Reader 1060. A mechanism, such as a Turnstile 1040 or an Optical Sensor 1050, to restrict a person without a valid identification from boarding is preferred. In this embodiment, the Magnetic Card Reader 1060 reads the contents of the Magnetic Boarding Pass 1001, and transmits the identity of the Passenger 1020, or other such information, to the Applications Processor 101 of the Reconciliation System which, in turn, stores and/or processes the information into the Database 110.

Radio Boarding Pass

[0064] The Radio Boarding Pass 1003 is a device with an embedded Tag that is a functional equivalent to the Tag 105-1 of FIG. 7-- that is the Radio Boarding Pass 1003 has a read-only Tag 105-1 containing the identification of the passengers, among other data Thus, the identity of the Passenger 1020 can then be determined by an Interrogator 103 reading the Radio Boarding Pass 1003.

[0065] As disclosed below, using the incident RF field to power a Tag 105 will cause the effective range of that Tag 105 to be greatly reduced. Therefore, in order to read the Boarding Pass 1040 as the Passenger 1020 boards the aircraft, an Interrogator 103 should be located at the entrance of either the boarding ramp, or the entrance to the aircraft itself.

Passenger Card

[0066] The Passenger Card 1002 is a functional equivalent of the Tag 105-1 of FIG. 3 -- that is, the passenger card 1002 has read-write capabilities, i.e., data can be transmitted to the Card, stored on the Card, and retrieved from the Card. A Passenger Card 1002 would likely be initially issued to the Passenger 1020, and then re-used over numerous trips.

[0067] The Passenger Card 1002 is operable to respond to the Interrogation, Messaging, and Location services discussed above. Thus, using the Interrogation service, the identity of the Passenger 1020 boarding the aircraft can be determined; using the Messaging Mode, data can be transmitted to the Passenger Card 1002; and using the Location Mode, the location of the Passenger can be determined.

[0068] As the Passenger Card 1002 approaches the check-in counter, the Passenger Card 1002 could be interrogated by the Interrogator 103. The identity of the Passenger 1020 could then be determined, thereby allowing the attendants to greet the Passenger 1020 by name. In another embodiment of the Passenger Card 1002, the Passenger Card 1002 could contain information regarding the identification numbers of the pieces of baggage checked by this Passenger 1020, thereby facilitating retrieval of the baggage.

[0069] The Passenger Card 1002 could also be used by the Passenger 1020 to check in at an automated check-in station, such as a device similar to an Automated Teller Machine, thereby expediting airport check-in procedures. The automated facility could also provide seat assignment based upon preferences stored in the Passenger Card 1002.

[0070] What has been described is merely illustrative of the application of the principles of the present invention. Other arrangements and methods can be implemented by those skilled in the art without departing from the spirit and scope of the present invention.

Claims

1. A communication system comprising

   an interrogator (103);
   a first radio frequency tag (105) having information associated with a first item, the first radio frequency tag utilizing modulated backscatter to communicate with the interrogator; and

CHARACTERIZED BY

a second radio frequency tag (820) having information associated with a second item and the first item, the second radio frequency tag utilizing modulated backscatter to communicate with the interrogator.

2. A system as claimed in claim 1 wherein the first radio frequency tag is operable to perform interrogation services with the interrogator.

3. A system as claimed in claim 1 wherein the second radio frequency tag is operable to perform interrogation, location or messaging services with the interrogator.

4. A system as claimed in claim 1 comprising an identification card (1030) having identification information of a third item that is associated with the first item.

5. A system as claimed in claim 4 wherein the identification card is a radio frequency tag.

6. A system as claimed in claim 4 wherein the identification card is operable to perform interrogation or location services.

7. A system as claimed in claim 4 wherein the identification card stores passenger information.

8. A system as claimed in claim 4 wherein the identification card has information associated with the first item.

9. A system as claimed in claim 1 wherein the first radio frequency tag is a read-only tag.

10. A system as claimed in claim 1 wherein the second radio frequency tag is a read-write tag.

FIG. 1

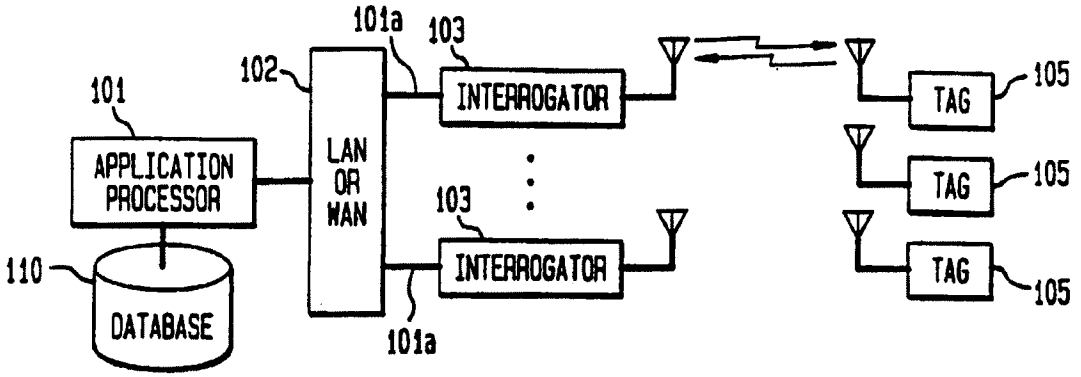

101a
103
102
INTERROGATOR
TAG
105
101
APPLICATION PROCESSOR
LAN OR WAN
103
TAG
105
INTERROGATOR
110
TAG
105
DATABASE
101a

FIG. 2

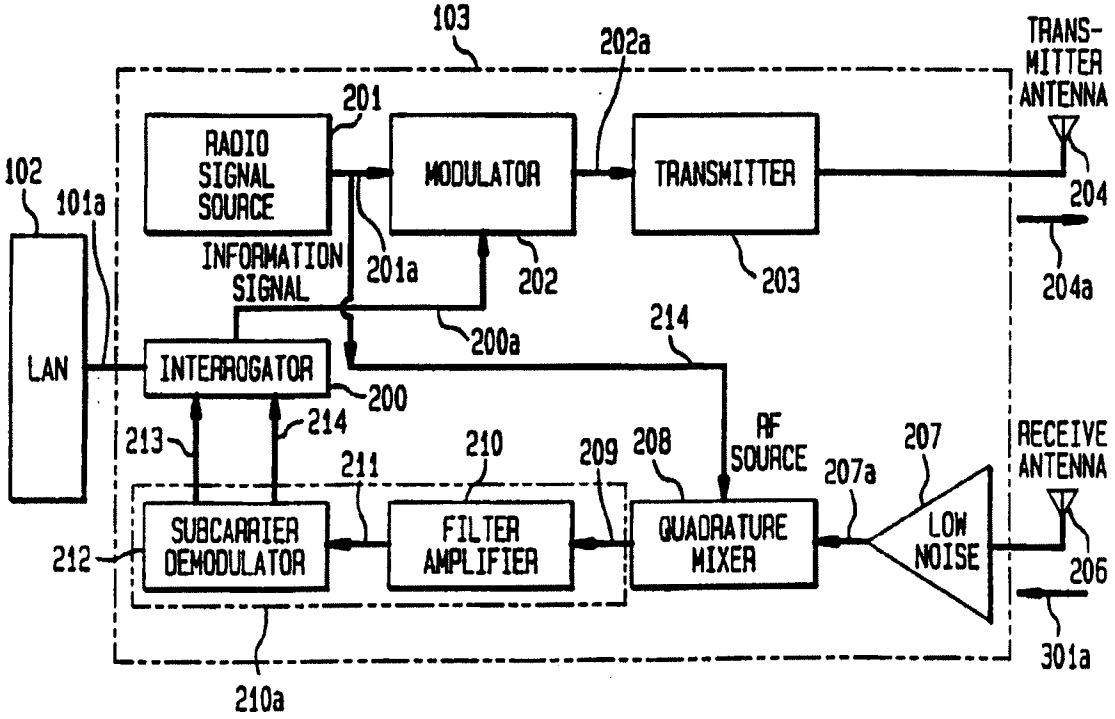

103
202a
TRANS-MITTER ANTENNA
201
RADIO SIGNAL SOURCE
MODULATOR
TRANSMITTER
102
101a
204
INFORMATION SIGNAL
201a
202
203
204a
200a
214
LAN
INTERROGATOR
200
213
214
RF SOURCE
207
RECEIVE ANTENNA
211
210
209
208
207a
SUBCARRIER DEMODULATOR
FILTER AMPLIFIER
QUADRATURE MIXER
LOW NOISE
212
206
301a
210a

FIG. 3

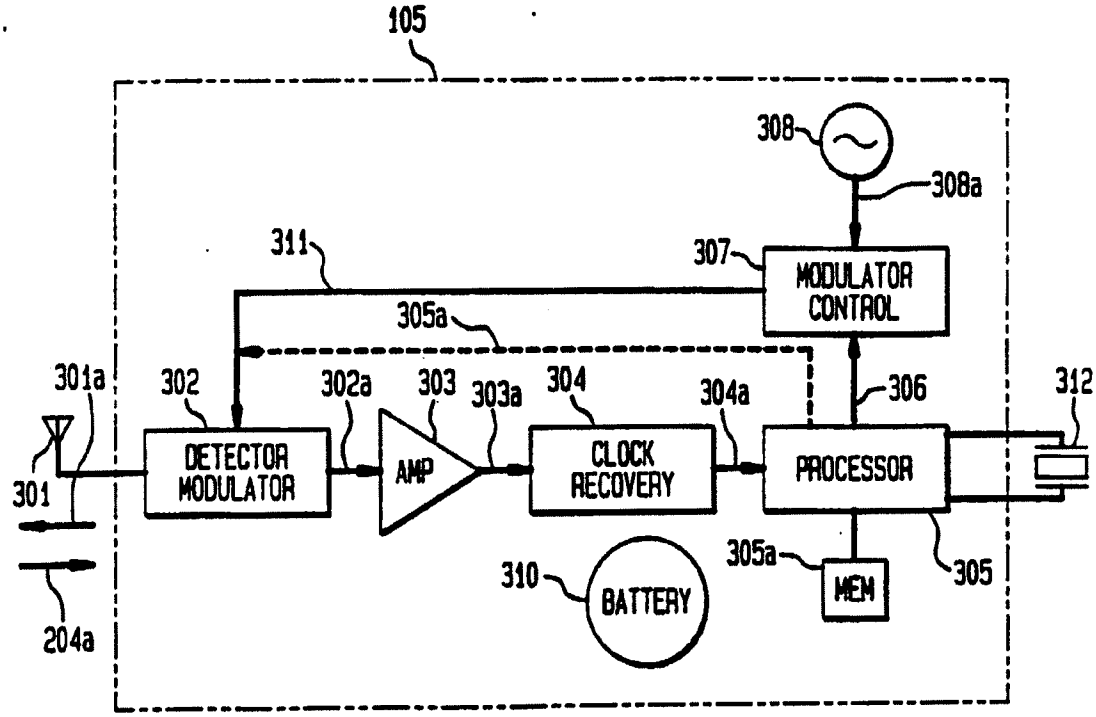

105
308
308a
311
307
MODULATOR CONTROL
305a
301a
302
302a
303
303a
304
304a
306
312
301
DETECTOR MODULATOR
AMP
CLOCK RECOVERY
PROCESSOR
310
BATTERY
305a
MEM
305
204a

FIG. 4

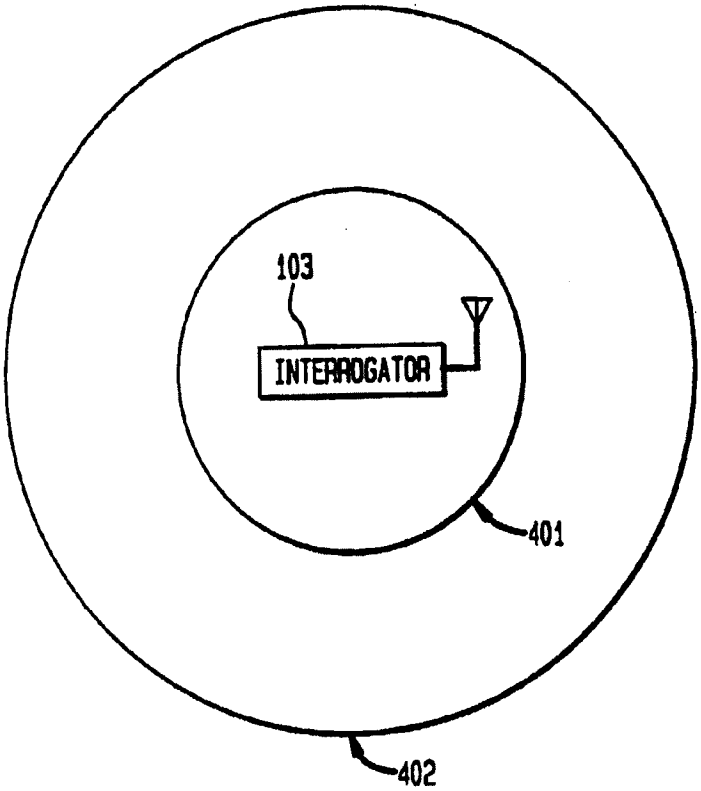

103
INTERROGATOR
401
402

FIG. 5

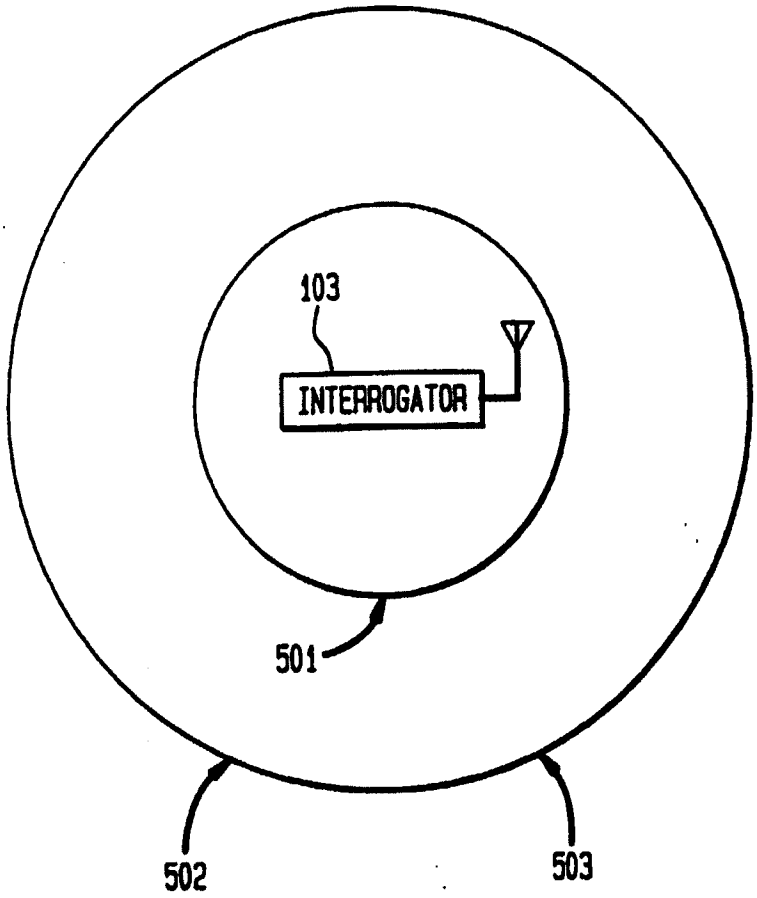


FIG. 6

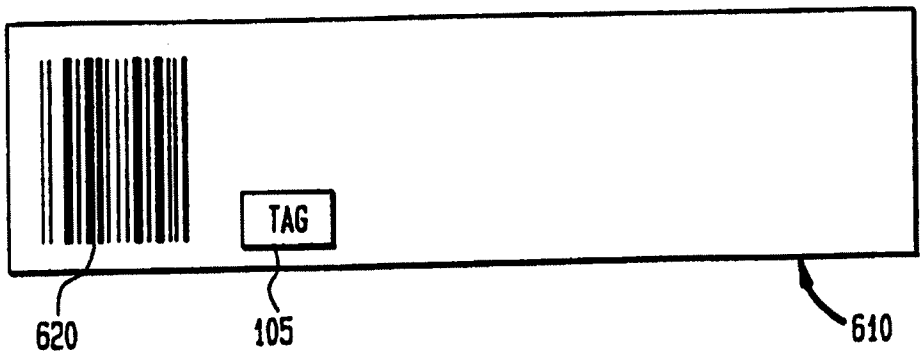


FIG. 7

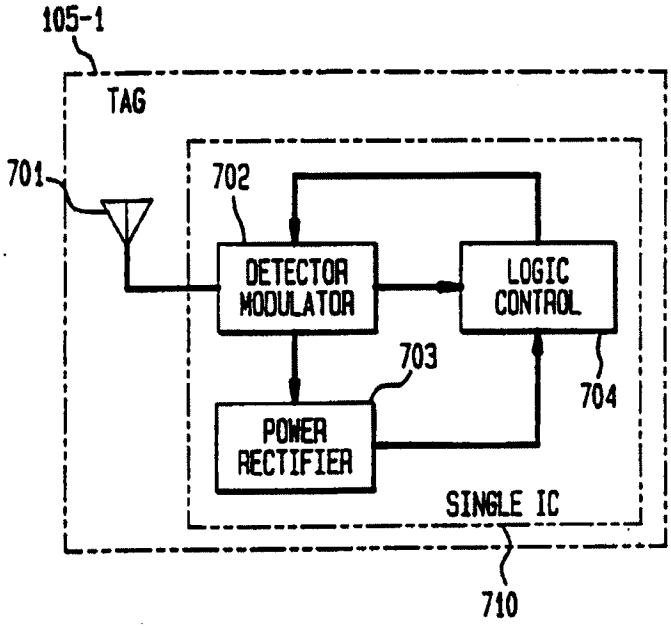

105-1
TAG
701
702
DETECTOR MODULATOR
LOGIC CONTROL
703
704
POWER RECTIFIER
SINGLE IC
710

FIG. 8

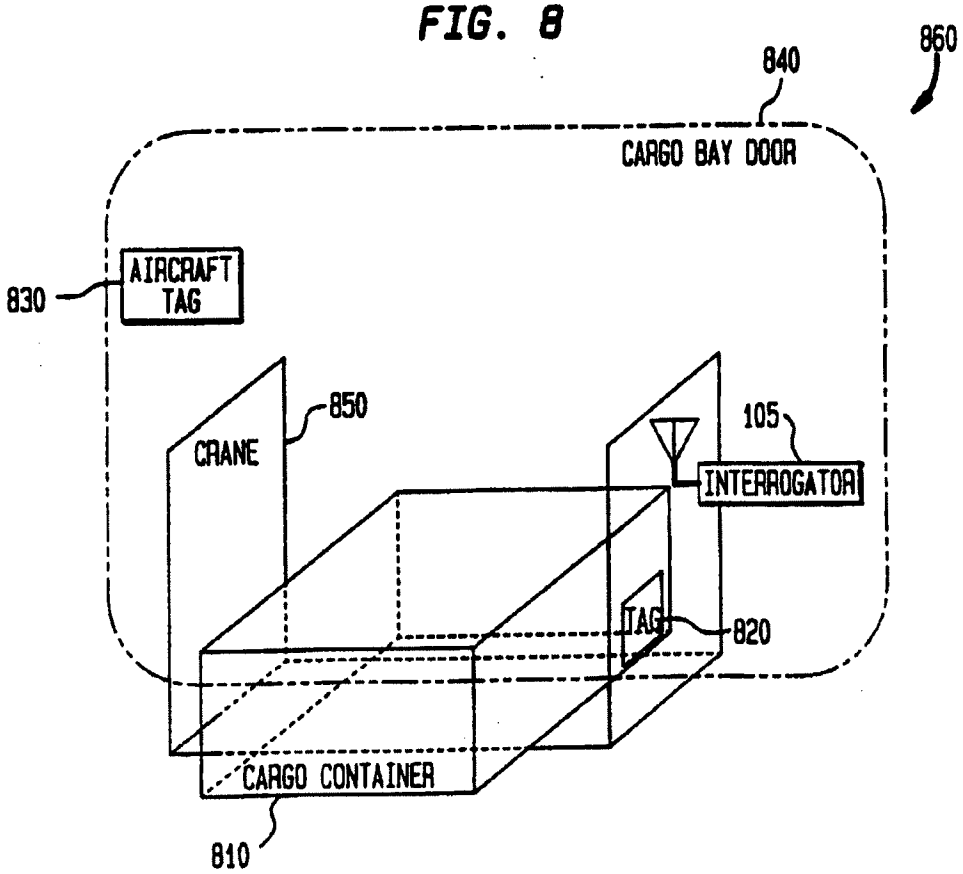
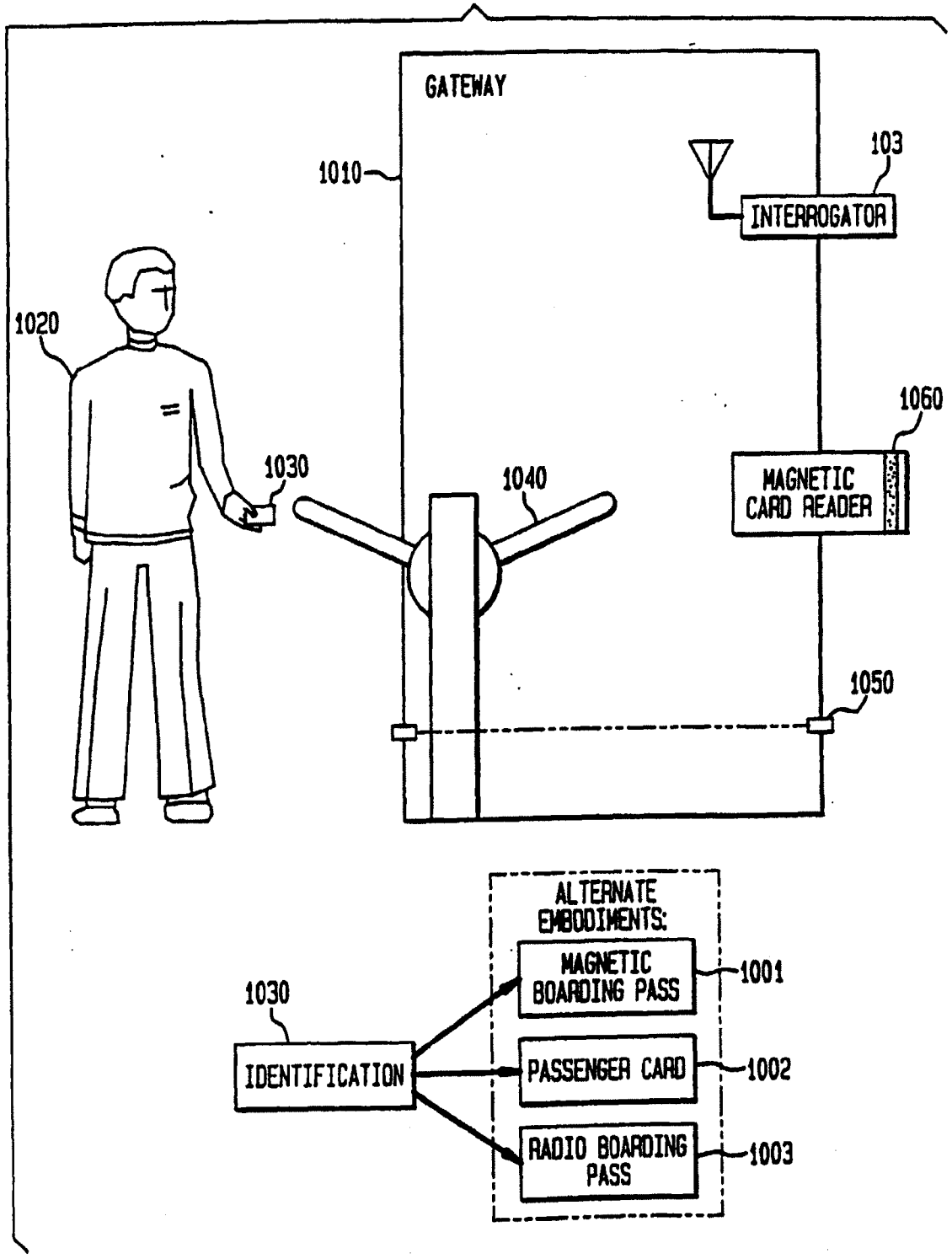

860
840
CARGO BAY DOOR
830
AIRCRAFT TAG
850
CRANE
105
INTERROGATOR
TAG
820
CARGO CONTAINER
810

FIG. 9


GATEWAY
1010
103
INTERROGATOR
1020
1030
1040
1060
MAGNETIC CARD READER
1050
ALTERNATE EMBODIMENTS:
1030
IDENTIFICATION
MAGNETIC BOARDING PASS
1001
PASSENGER CARD
1002
RADIO BOARDING PASS
1003

European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 99 20 1082

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
X	US 5 478 991 A (HIRATA TATSUYA ET AL) 26 December 1995 (1995-12-26) * column 2, line 60 - column 9, line 17; figures 1-19 *	1-10	G06K7/00
X	EP 0 520 455 A (NIPPON DENSO CO) 30 December 1992 (1992-12-30) * column 3, line 21 - column 12, line 10; figures 1-19 *	1-10	
A	EP 0 670 558 A (AT & T CORP) 6 September 1995 (1995-09-06) * column 3, line 11 - column 6, line 13; figure 1 *	1,10	
A	WO 94 19781 A (KIP HARM JACOB ;NEDAP NV (NL)) 1 September 1994 (1994-09-01) * page 5, line 13 - page 9, line 17; figures 1-3 *	1-3	
			TECHNICAL FIELDS SEARCHED (Int.Cl.6)
			G06K

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	14 July 1999	Degraeve, A

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

EPO FORM 1503 03.82 (P04C01)

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 99 20 1082

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

14-07-1999

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		AU 653828 B	13-10-1994
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		DE 69215150 D	19-12-1996
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		AU 653828 B	13-10-1994
		AU 1868192 A	07-01-1993
		DE 69215150 D	19-12-1996
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		US 5873025 A	16-02-1999
WO 9419781 A	01-09-1994	NL 9300290 A	16-09-1994

PATENT ABSTRACTS OF JAPAN

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(22)Date of filing : 09.01.2001

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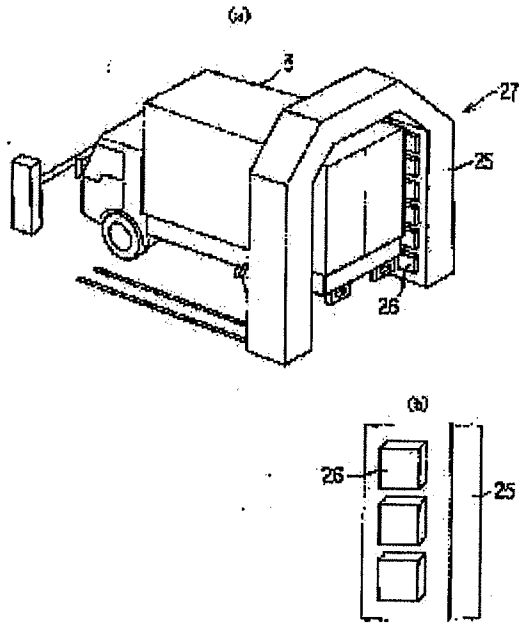
(72)Inventor : KIKUCHI YUJI
SATO MASAHIKO
ISHIBASHI SHINYA

(54) ARTICLE DETECTING SYSTEM

(57)Abstract:

PROBLEM TO BE SOLVED: To detect the position of a specific baggage from among many pieces of baggage loaded on a truck.

SOLUTION: An ID tag in which identification information, a destination, etc., are written is fitted to the baggage to be loaded to a truck 3. Many antenna setting parts 26 with transmitting and receiving antennas mounted thereto are arranged to an intermittently moving gate 25 in order to search for the specific baggage after the baggage are loaded to the truck 3. The transmitting and receiving antennas of the antenna setting parts are sequentially effectuated to communicate with the ID tag, whereby an identification number is read out. When the read identification number is equal to an identification number of the specific baggage, the position of the specific baggage is detected from a position of the transmitting and receiving antennas communicating at the time.



(19)日本国特許庁（ＪＰ）　(12)**公開特許公報（Ａ）**　(11)特許出願公開番号
特開2002－207079
（P2002－207079A）
(43)公開日　平成14年７月26日(2002.7.26)

(51)Int.Cl.[7]	識別記号	ＦＩ		テーマコード(参考)
Ｇ０１Ｓ　13/74		Ｇ０１Ｓ　13/74		５Ｂ０５８
Ｂ６５Ｇ　61/00	５２６	Ｂ６５Ｇ　61/00	５２６	５Ｊ０７０
Ｇ０６Ｋ　17/00		Ｇ０６Ｋ　17/00	Ｆ	
			Ｌ	

審査請求　未請求　請求項の数１　ＯＬ　（全７頁）

(21)出願番号　特願2001－1520(P2001－1520)

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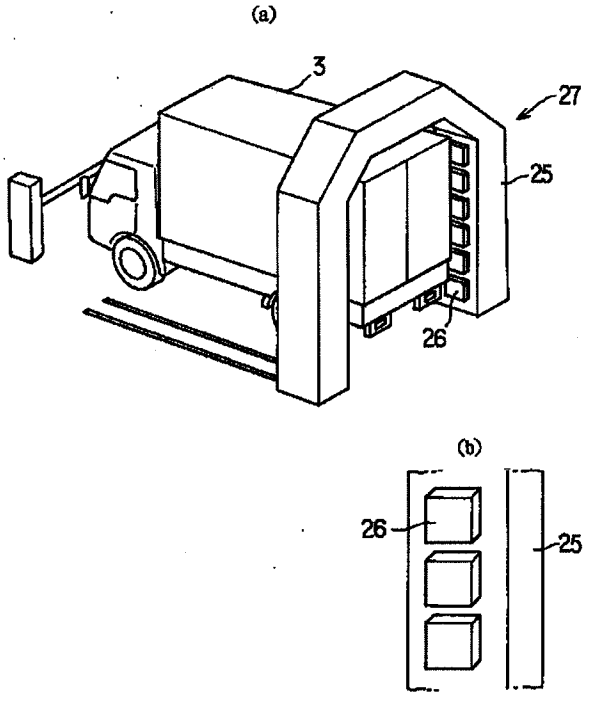
最終頁に続く

(54)【発明の名称】　物品検出システム

(57)【要約】
【課題】　トラックに積み込まれた多数の荷物の中から特定の荷物の位置を検出する。
【解決手段】　トラック３に積み込まれる荷物に、識別情報、行き先などを書き込んだＩＤタグを取り付ける。荷物をトラック３に積み込んだ後、特定の荷物を探し出すには、間欠的に移動するゲート２５に送信および受信アンテナを取り付けたアンテナ取付部２６を多数設け、そのアンテナ取付部の送信および受信アンテナを順次有効化してＩＤタグと通信し、識別番号を読み取る。読み取った識別番号が特定荷物の識別番号と同じであった場合、そのとき通信していた送信および受信アンテナの位置から、特定荷物の位置を検出する。



【特許請求の範囲】

【請求項１】　積み置かれる物品に取り付けられ、当該物品の識別情報を書き込んだＩＤタグと、

前記積まれた多数の物品に対して、前記物品のＩＤタグと通信するための電波を、縦方向、横方向および高さ方向に順次位置を違えて放射するアンテナ装置を備え、ＩＤタグから前記識別情報を読み出す読取手段と、

前記物品のＩＤタグと通信した時の前記アンテナ装置の電波放射位置に基づいて、前記物品の位置を検出する位置検出手段とを具備してなる物品検出システム。

【発明の詳細な説明】

【０００１】

【発明の属する技術分野】本発明は積まれた多数の物品の中から特定の物品の位置を検出できるようにした物品検出システムに関する。

【０００２】

【発明が解決しようとする課題】例えば、物流の集配業務において、荷物は集配センターに集められ、そこで行き先別に分けられてトラックに積み込まれる。荷物が一旦トラックに積み込まれると、或る特定の荷物を取り出したい時、その荷物の所在を特定できない場合が多く、そのような時には、トラックから荷物を降ろしたりして、一つ一つ確認する必要があった。本発明は上記の事情に鑑みてなされたもので、その目的は、積まれた物品の所在を検出することができる物品検出システムを提供するにある。

【０００３】

【課題を解決するための手段】本発明は、積み置かれる物品に取り付けられ、当該物品の識別情報を書き込んだＩＤタグと、前記積まれた多数の物品に対して、前記物品のＩＤタグと通信するための電波を、縦方向、横方向および高さ方向に順次位置を違えて放射するアンテナ装置を備え、ＩＤタグから前記識別情報を読み出す読取手段と、前記物品のＩＤタグと通信した時の前記アンテナ装置の電波放射位置に基づいて、前記物品の位置を検出する位置検出手段とを設けたものである。

【０００４】例えば、トラックに積み込まれた多数の荷物の中から、或る特定の荷物を取り出す場合、読取手段のアンテナ装置から縦方向、横方向および高さ方向に順次位置を違えて電波を放射する。アンテナ装置から放射される電波は指向性が高いので、読取手段がＩＤタグと通信した時の電波の放射位置が分かれば、その電波の放射位置から、物品の位置を大まかに特定できる。従って、取り出したい荷物のＩＤタグと通信した時の電波の放射位置を求めれば、その位置から荷物の大体の位置が分かるから、全部の荷物を降ろさなくとも、その近辺の荷物を調べれば、探している荷物を見つけることができる。

【０００５】

【発明の実施の形態】以下、本発明の第１実施例を荷物をトラック輸送する場合の集配センターに適用して図１ないし図９を参照しながら説明する。図９は集配センターを示す。同図に示すように、集配センターには、コンベアラインによって構成される複数の仕分けライン１が設けられている。各仕分けライン１は、行き先別に仕分けた荷物（物品）２を移動体としてのトラック３の発着所まで搬送するもので、各仕分けライン１により送られてきた荷物２は、一旦、積載準備場所Ｅに降ろされる。なお、トラック３の発着所は各仕分けライン１に一対一の関係で設けられている。

【０００６】上記荷物２には、図７に示すように、ＩＤタグ４が取り付けられている。このＩＤタグ４は、図６に示す読取手段としてのリーダライタ５との間で電波により通信できるようになっている。このリーダライタ５はトラック３の発着所毎に設けられている。ここで、ＩＤタグ４およびリーダライタ５の電気的構成を説明する。

【０００７】まず、図５はＩＤタグ４の電気的構成を示すもので、電波信号を送受信するための通信手段としてのアンテナ用コイル６と、共振コンデンサ７と、制御用ＩＣ８と、平滑部９とを備えている。制御用ＩＣ８は、制御手段としてのＭＰＵ（マイクロプロセッサユニット）１０の他、整流部１１、変復調部１２、識別情報記憶手段としてのメモリ部１３などを構成する半導体素子をワンチップ化したものである。この場合、メモリ部１３は、動作プログラマブルなどを記憶したＲＯＭと、一時記憶用として消去可能な不揮発性メモリ、例えばＥＥＰＲＯＭとを有している。

【０００８】そして、ＩＤタグ４のメモリ部１３のＥＥＰＲＯＭには、図８に示すように、ＩＤタグ４が取り付けられた荷物２の識別番号（識別情報）、送荷先、送荷元、内容物、割れ物、精密機器か否か、荷物２の寸法などの各種情報が記憶されている。

【０００９】上記アンテナ用コイル６は、共振コンデンサ７と並列に接続されて共振回路を構成し、外部機器から所定の高周波数の電力用電波信号が送信されてくると、これを受信して整流部１１に供給する。整流部１１は、平滑部９と共に動作用電源回路を構成するもので、共振回路から送信されてきた電力用電波信号を整流し、平滑部９により平滑化し且つ一定電圧の直流電力（動作用電力）にしてＭＰＵ１０などに供給する。

【００１０】外部機器から送信されてくるデータなどの信号は、電力用電波信号に重畳して送信されるようになっており、その信号は、変復調部１２により復調されてＭＰＵ１０に与えられる。ＭＰＵ１０は、メモリ部１３のＲＯＭに記憶された動作プログラムに従って動作するもので、変復調部１２から入力される信号に応じた処理を実行し、受信したデータをメモリ部１３のＥＥＰＲＯＭなどに書き込んだり、ＥＥＰＲＯＭからデータを読み出して変復調部１２により変調し、アンテナ用コイル６

から電波信号として送信したりする。

【００１１】一方、リーダライタ５は、図６に示すように、制御手段としてのＭＰＵ１４、送信アンテナ１５を有する送信部１６、受信アンテナ１７を有する受信部１８、動作プログラムを記憶したＲＯＭ１９、ＲＡＭ２０などを備えている。このリーダライタ５は、ＩＤタグ２と通信する場合、まず、キャリア信号を送信部１６で変調して電力用電波信号として送信アンテナ１５から送信し、その後、送信すべきデータをその電力用電波信号に重畳するように送信部１６で変調して送信アンテナ１５から送信する。ＩＤタグ２から送信された電波信号については、これを受信アンテナ１７で受信し、受信部１８で復調してデータとして弁別する。そして、ＭＰＵ１４は、受信部１８で復調したデータをＲＡＭ２０に記憶し、その記憶データは位置検出手段としての制御装置２１に入力されるようになっている。この制御装置２１はパソコンから構成され、ＬＣＤなどの表示器２２、プリンタ２３およびキーボードなどの操作部２４を備えている。

【００１２】さて、集配センターの複数あるトラック発着所には、図３、図４に示すようにほぼ逆Ｕ字状のゲート２５が設けられている。このゲート２５はトラック３がくぐることができるような大きさに構成され、トラック３の前後方向に沿って１ピッチずつ移動できるようになっている。このゲート２５には、多数のアンテナ取付部２６がゲート２５に沿って一列に設けられている。

【００１３】前記リーダライタ５の送信アンテナ１５および受信アンテナ１７は同心状のコイルに形成され、上記ゲート２５の各アンテナ取付部２６に一組ずつ配置されてゲート２５と共にアンテナ装置２７を構成している。リーダライタ５がＩＤタグ４と通信する場合、各アンテナ取付部２６のアンテナ１５および１７はＭＰＵ１４によって制御されるスイッチ要素２８により、一組ずつ順番に送信部１６および受信部１８に接続され、その接続が一巡するとゲート２５が１ピッチ移動して再び各アンテナ取付部２６のアンテナ１５および１７が一組ずつ順番に送信部１６および受信部１８に接続される、という動作を繰り返すようになっている。従って、電波を放射する送信アンテナ１５とＩＤタグ４から放射される電波を受信する受信アンテナ１７の位置は、水平面の縦方向および横方向並びに高さ（鉛直）方向に順次変化するようになっている。なお、ＩＤタグ４が通信動作を行う場合は、送信アンテナ１５から放射される電波がアンテナコイル６と鎖交して誘導電流が発生する場合である。

【００１４】リーダライタ５がＩＤタグ４から荷物２についての情報を読み取ると、リーダライタ５は、その読み取った情報を制御装置２１に送信すると共に、その読み取り時に電波信号の送受信を行ったアンテナ１５、１７の位置を、アンテナ取付部２６の位置で検出して制御装置２１に送信する。また、その時のゲート２５の位置は、図示しない位置検出装置により検出されて制御装置２１に送信されるようになっている。そして、制御装置２１は、荷物２の識別番号と、その荷物２のＩＤタグ４と通信した時のアンテナ取付部２６およびゲート２５の位置（アンテナ位置情報）とを図示しない記憶装置に記憶するようになっている。

【００１５】制御装置２１は、上記のアンテナ位置情報に基づいて、指定された識別番号の荷物２の所在情報を出力する。すなわち、送信アンテナ１５から送信される電波は指向性が高いので、その到達範囲はアンテナ取付部２６から真っ直ぐ前方の狭い領域に限られる。このため、或る位置に存在する荷物２のＩＤタグ４は、ゲート２５がほぼ真横から真上にかけて位置するようになったときに、各アンテナ取付部２６のうち、いずれか一つ或いは複数のアンテナ取付部２６の送信アンテナ１５から送信されてくる電波に反応して送信動作を行う。従って、リーダライタ５がＩＤタグ４からの電波を受信した時に送信部１６および受信部１８に接続されていたアンテナ１５および１７の位置が分かれば、ＩＤタグ４（荷物２）の位置を特定できるものである。

【００１６】制御装置２１が表示器２２或いはプリンタ２３に出力する荷物２の所在情報は、具体的には、図２に示すように、ＩＤタグ４からの電波を受信したアンテナ取付部２６の位置を、横（トラック３の幅方向）Ｗ、縦（トラック３の前後方向）Ｌおよび高さＨで表示されると共に、トラック３の荷台における荷物２の位置を三次元図形で表示される。

【００１７】ちなみに、トラック３の荷台に荷物２を積込む際、その荷物２の大きさが揃っていれば、縦横に整列して積込まれるが、不揃いの場合には、無造作に積み上げられる。このように場合場合によって、ＩＤタグ４のアンテナ用コイル６の向きが荷物毎に異なるようになるが、いずれの場合でも、ゲート２５からは、ほぼ真横に高さを違えて、或いは斜め下方に、更にはほぼ真下に縦方向に位置を違えて電波が放射されるので、ゲート２５がほぼ真横から真上にかけて位置するようになった荷物２のＩＤタグ４は、複数のアンテナ取付部２６のうちの少なくとも一つから放射される電波を受信して動作するようになる。従って、リーダライタ５と送受信したときの荷物２に取り付けられたＩＤタグ４は、少なくとも１か所から放射される電波に反応して通信動作するので、その電波の放射位置から、縦（Ｌ）方向の位置と高さ、或いは縦方向と横方向の位置を特定できるものである。

【００１８】なお、図２はゲート２５の高さ方向に並ぶアンテナ取付部２６のいずれか、およびゲート２５の上部に横方向に並ぶアンテナ取付部２６のいずれかの２か所のアンテナ取付部２５のアンテナ１５、１７を介してリーダライタ５と送受信して縦、横、高さの３次元の位

置を特定できた場合を示す。

【００１９】次に上記構成の作用を説明する。仕分けライン１によりトラック３の発着所へ送られてきた荷物２は、作業者によって荷物準備場所Ｅに降ろされ、そして順次、トラック３の荷台に積み込まれる。全部の荷物２を積み込んだ後、例えば、或る荷物２を間違って積み込んだことが分かり、その荷物２をトラック３から降ろさねばならないような場合がある。この場合には、その間違って積み込んだ荷物（以下、特定荷物）２の識別番号を制御装置２１に入力し、その識別番号をもったＩＤタグ４（特定荷物２）の所在を検出させる。

【００２０】このＩＤタグ４の所在を検出する場合の制御装置２１の作用を図１のフローチャートをも参照しながら説明する。すなわち、まず、ゲート２５を始点位置であるトラック３の例えば荷台の最後部に位置させ（ステップＳ１）、そして、ゲート２５の各アンテナ取付部２６のアンテナ１５および１７を、順次、送信部１６および受信部１８に接続して、リーダライタ５に通信動作を行わせる（アンテナスキャン；ステップＳ２）。これにより、各アンテナ取付部２６のアンテナ１５および１７が順次有効化され、そして、有効化された送信アンテナ１５が送信部１６からの電力用信号およびデータ信号を電波信号として送信する（ステップＳ２）。

【００２１】この送信アンテナ１５から放射される電波信号を受信したＩＤタグ４は、メモリ部１３に記憶した荷物２の識別番号を送信する。このＩＤタグ４が送信した識別番号は受信アンテナ１７に受信され、リーダライタ５のＭＰＵ１４によって制御装置２１に送信される。制御装置２１は、リーダライタ５から送られてきたＩＤタグ４の識別番号が特定荷物２の識別番号と一致する場合（ステップＳ３で「ＹＥＳ」）、そのＩＤタグ４と通信したときのアンテナ取付部２５の位置およびゲート２７の位置を図示しない記憶装置に記憶する（ステップＳ４）。

【００２２】全てのアンテナ取付部２６のアンテナ１５および１７が有効化されると、制御装置２１は、ゲート２７が終点位置である最前部まで移動した位置にあるか否かを判断し（ステップＳ５）、終点位置にない場合には（ステップＳ５で「ＮＯ」）、ゲート２７を前方に１ピッチ移動させる（ステップＳ６）。以後、前述したステップＳ２～Ｓ６と同様の処理を、ゲート２５の終点位置でアンテナスキャンが終了するまで繰り返し実行する。

【００２３】そして、制御装置２１は、特定荷物２のＩＤタグ４と通信したときのアンテナ取付部２６の位置に基づいて特定荷物２の位置を検出し、表示器２２に表示すると共に、プリンタ２３によって打ち出す。

【００２４】さて、表示器２３に表示され、或いはプリントされた用紙から、特定荷物２のおおよその位置が分かるので、作業者はその位置から特定荷物２を見つけ出し、トラック３の荷台から降ろす。

【００２５】図１０および図１１は本発明の第２および第３実施例のアンテナ装置を示すもので、図１０の第２実施例のアンテナ装置２８が前記第１実施例のアンテナ装置２７と異なるところは、ゲート２５にレール２９を設け、このレール２９にゲート２５に沿って移動可能な１個のアンテナ取付部２６を設け、そしてアンテナ取付部２６を駆動ベルト３０によって移動させるようにしたところにある。このアンテナ取付部２６の位置は位置検出手段、例えば駆動ベルト３０の図示しない駆動モータの回転位置を検出するロータリエンコーダにより検出され、制御装置２１に入力されるようになっている。

【００２６】このアンテナ装置２８では、ゲート２５を間欠的に移動させ、ゲート２５の各停止位置でアンテナ取付部２６をゲート２５に沿って移動させながら送信アンテナ１５から電波を放射し、受信アンテナ１７がＩＤタグ４からの電波を受信したときのアンテナ取付部２６の位置とゲート２５の位置とから特定荷物２のＩＤタグ４の位置を検出するものである。

【００２７】図１１の第３実施例のアンテナ装置３１は、トラック３が収容される大きさのトンネル３２を設け、このトンネル３２に多数のアンテナ取付部２６を整列状態に設けたものである。このアンテナ装置３１では、送信部１６および受信部１８に接続するアンテナ１５および１７を順に変更（スキャン）し、ＩＤタグ４からの電波を受信したときのアンテナ取付部２６の位置から特定荷物２のＩＤタグ４の位置を検出するものである。

【００２８】なお、本発明は上記し且つ図面に示す実施例に限定されるものではなく、以下のような拡張或いは変更が可能である。積荷情報は荷物２の識別番号だけであっても良い。ゲート２５は固定で、トラック３側が移動するように構成しても良い。荷物の配送に限らず、工場で移動ロボット（移動体）により部品を搬送する場合などに適用しても良い。移動体に積み込まれた物品の位置を検出する場合に限らず、床面に積まれた多数の物品の中から特定の物品を探し出す場合に適用しても良い。積み置かれる物品のすべてにＩＤタグが取り付けられている必要はない。

【図面の簡単な説明】

【図１】本発明の第１実施例を示すもので、特定荷物を探し出す場合のフローチャート

【図２】特定荷物の位置を表示した図

【図３】（ａ）はアンテナ装置全体の斜視図、（ｂ）は部分拡大図

【図４】アンテナ装置の断面図

【図５】ＩＤタグの電気的構成を示すブロック図

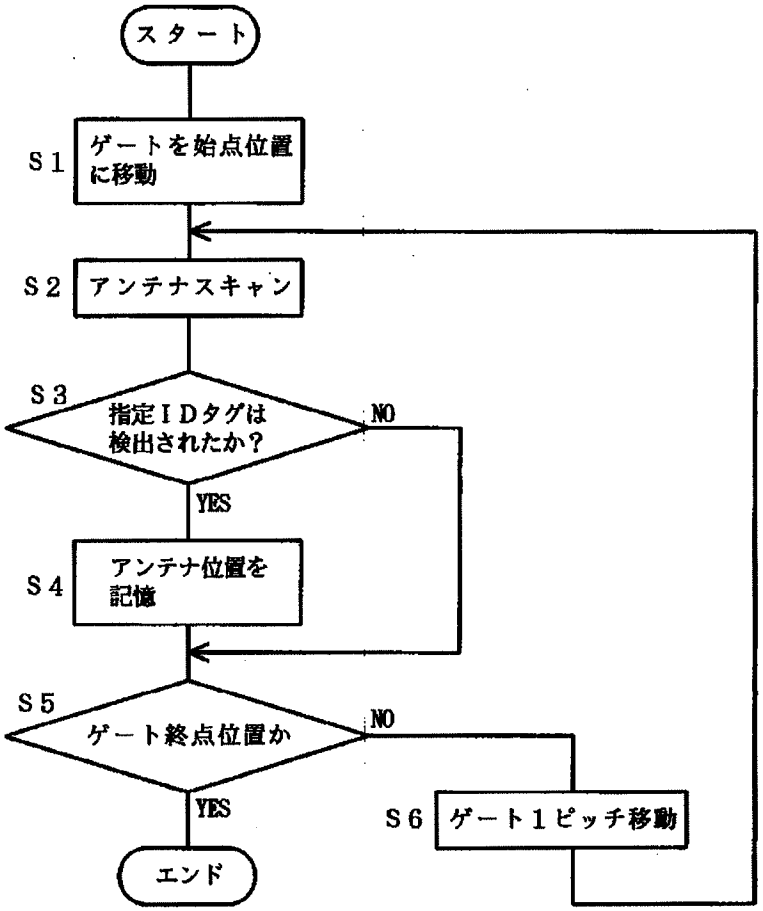
【図６】リーダライタと制御装置の電気的構成を示すブロック図

【図７】荷物の斜視図

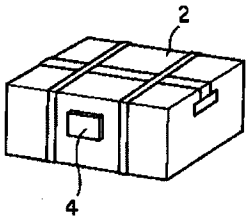
【図８】ＩＤタグへの書き込み情報を示す概念図
【図９】集配センターの平面図
【図１０】本発明の第２実施例を示す図３相当図
【図１１】本発明の第３実施例を示す図３相当図
【符号の説明】

図中、２は荷物（物品）、３はトラック、４はＩＤタグ、５はリーダライタ（読取手段）、２１は制御装置（位置検出手段）、２５はゲート、２６はアンテナ取付部、２７、２８、３１はアンテナ装置である。

【図１】



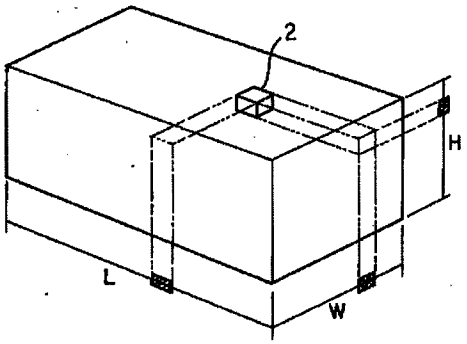
【図７】



【図８】

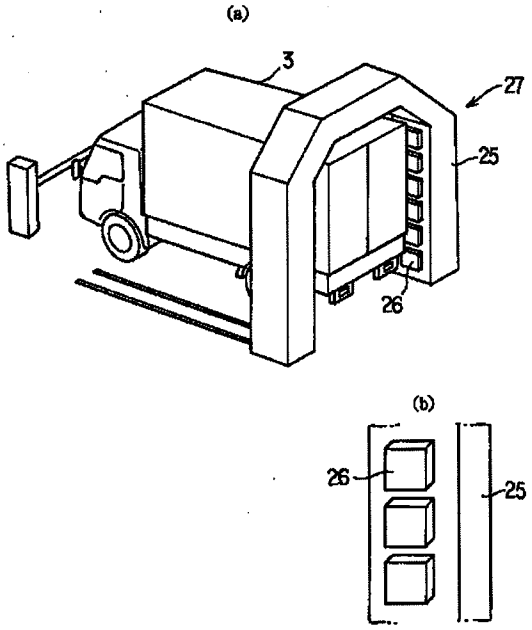
項　目	内　容
タグID	１２３４５
送荷先	○○県△△市
送荷元	□□県××市
内容物	＊＊＊＊＊
われもの	あり
精密機器	なし
外形	○○× ○○× ○○

【図２】

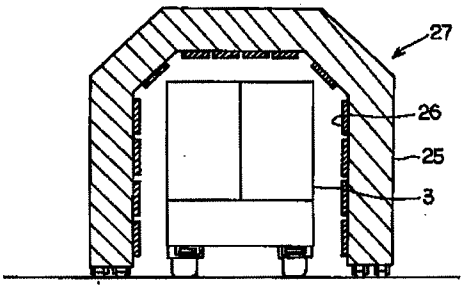


L：○○○
W：○○○
H：○○○

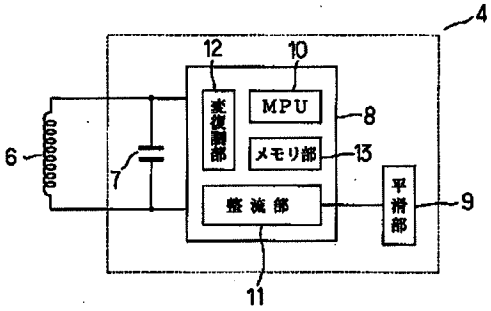
【図３】



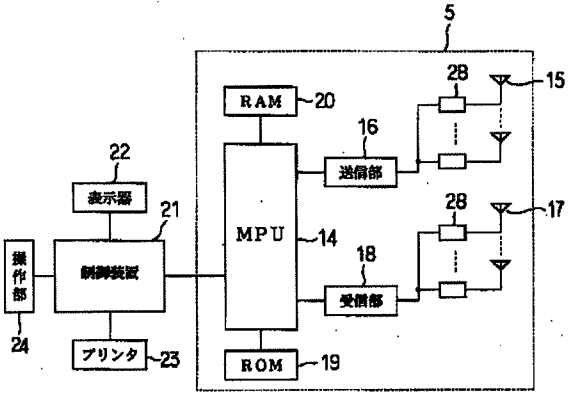
【図４】



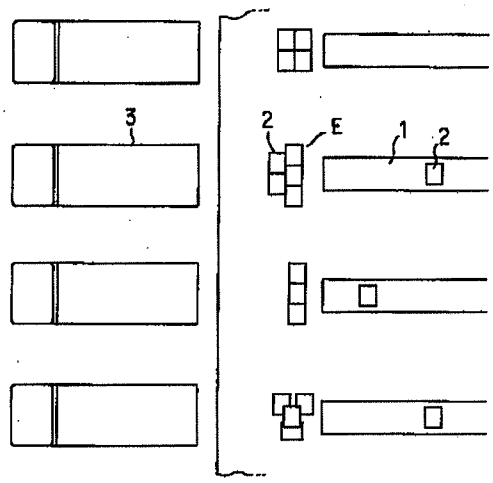
【図５】



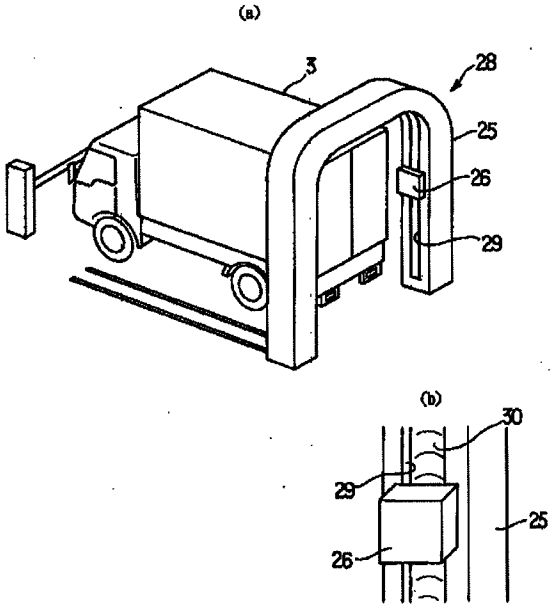
【図６】



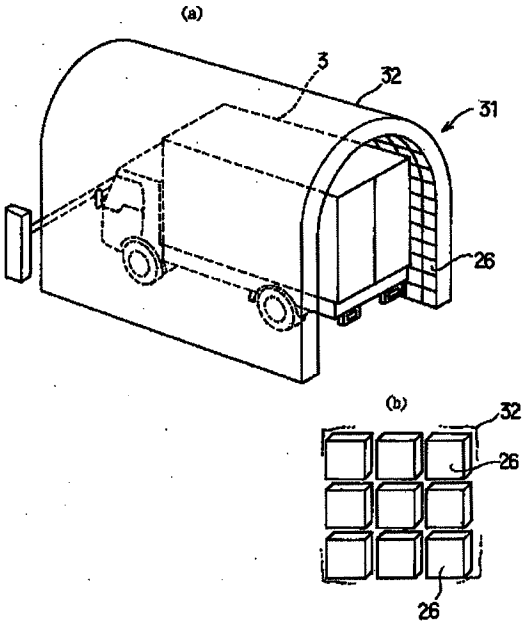
【図９】



【図１０】



【図１１】



フロントページの続き

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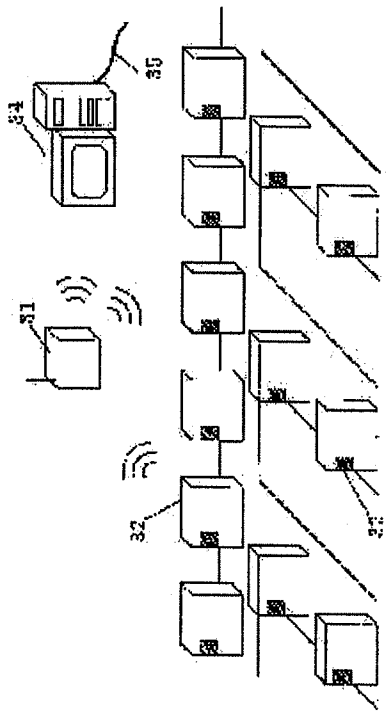
(54) WIRELESS COMMUNICATION CONTROL SYSTEM

(57)Abstract:

PROBLEM TO BE SOLVED: To provide a wireless communication control system capable of remarkably reducing processes needing the manpower to reduce the cost and to shorten a time.

SOLUTION: This wireless communication control system comprises a wireless communication device 33 attached to the baggage and having a memory, an access point device 31 capable of wirelessly communicating with the wireless communication device 33, a personal computer 34 capable of wirelessly communicating with the access point device 31 to read out the contents in the memory of the wireless communication device 33 through the access point device 31, and a network 35 such as a telephone line.



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	５０６		５０６	５Ｋ０６７

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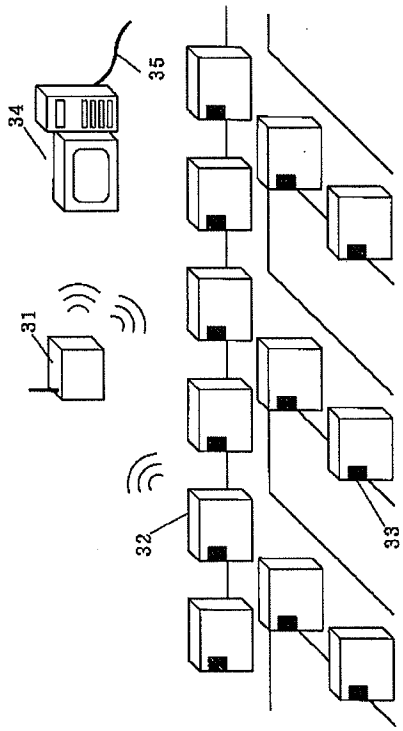
(54)【発明の名称】　無線通信管理システム

(57)【要約】
【課題】　人手が必要な工程を大幅に削減してコスト低減と時間短縮を図ることができる無線通信管理システムを提供することを目的とする。
【解決手段】　荷物に配設されメモリを有する無線通信装置３３と、無線通信装置３３と無線通信を行うことが可能なアクセスポイント装置３１と、アクセスポイント装置３１と無線通信を行うことが可能でアクセスポイント装置３１を介して無線通信装置３３のメモリの内容を読み出すことができるパーソナルコンピュータ３４と、電話回線等のネットワーク３５とを有する。



【特許請求の範囲】
【請求項１】荷物に配設されメモリを有する無線通信装置と、前記無線通信装置と無線通信を行うことが可能なアクセスポイント装置と、前記アクセスポイント装置と無線通信を行うことが可能で前記アクセスポイント装置を介して前記無線通信装置のメモリの内容を読み出すことができるパーソナルコンピュータと、電話回線等のネットワークとを有することを特徴とする無線通信管理システム。
【請求項２】荷物を配送するトラックを備え、前記トラックは、トラック用アクセスポイント装置と、トラック用パーソナルコンピュータと、位置情報を知らせるナビゲーションシステムと、携帯電話機とを有することを特徴とする請求項１に記載の無線通信管理システム。
【請求項３】前記無線通信装置に代えて、社員カードに配設されメモリを有するカード用無線通信装置を有することを特徴とする請求項１に記載の無線通信管理システム。
【請求項４】前記アクセスポイント装置は店の出入り口近傍に配設されたことを特徴とする請求項１に記載の無線通信管理システム。
【請求項５】メモリを有するカード用無線通信装置が配設された社員カードと、前記社員カードの在・不在を検出する在・不在管理サーバーと、前記在・不在管理サーバーとの通信が可能でボイスメール機能を有するＰＢＸシステムと、前記カード用無線通信装置と無線通信を行うことが可能なアクセスポイント装置と、前記アクセスポイント装置と無線通信を行うことが可能なパーソナルコンピュータとを有することを特徴とする無線通信管理システム。
【請求項６】物流在庫管理を行う無線通信管理システムであって、荷物に配設されメモリを有する無線通信装置と、前記無線通信装置と無線通信を行うことが可能なアクセスポイント装置と、前記アクセスポイント装置と無線通信を行うことが可能で前記アクセスポイント装置を介して前記無線通信装置のメモリの内容を読み出すことができるパーソナルコンピュータとを有することを特徴とする無線通信管理システム。
【請求項７】メモリを有しクリップにより荷物に取り付けることが可能なクリップ型無線通信装置と、前記メモリの内容の読出しと前記クリップ型無線通信装置のクリップの取外しが可能な自動情報読取り・取外し装置と、前記自動情報読取り・取外し装置との通信が可能なＰＯＳシステムとを有することを特徴とする無線通信管理システム。
【発明の詳細な説明】
【０００１】
【発明の属する技術分野】本発明は、メモリ内蔵の無線通信装置を用いて種々の管理やチェックを行う無線通信管理システム（例えば物流システム、チェックシステム、在・不在管理システム、ＰＯＳシステム）に関する。
【０００２】
【従来の技術】近年、物流システム、ＰＯＳシステムにおいては、バーコードを利用した管理システムが導入され、作業工程の効率化が大幅に図られている。また、チェックシステムにおいては、社員証や会員証をカード読取り装置に挿入することによりドアの開閉を実施したり、磁界を利用した商品タグと磁界センサとから構成される万引き防止システムが利用されている。しかし、まだ全自動化までは実施されておらず、部分的に人による作業が発生している。
【０００３】以下、バーコードを利用した従来の無線通信管理システムとしての物流システムについて説明する。
【０００４】図１０、図１１はバーコードを利用した従来の無線通信管理システムとしての物流システムを示す構成図である。
【０００５】図１０において、１０１は荷送人情報、荷受人情報、品名情報等を記入する送付用伝票、１０２は集荷された荷物を管理する物流センター内の物流管理サーバー、１０３は物流センターに集荷された荷物、１０４は予め必要事項が記入された送付用伝票、１０５はセンター内で送付用伝票１０４上のバーコードを読み取り、宛先毎に分別収集する指示を出すバーコード読取り装置である。また、図１１において、１１１は荷物、１１２は送付用伝票、１１３は携帯型バーコード読取り装置である。
【０００６】以上のように構成された物流システムについて、その動作を説明する。
【０００７】図１０において、まず、発送したい荷物を所定の集荷場所に持参し、送付用伝票１０１に荷物を送付したい荷送人情報、荷受人情報、品名情報等の必要事項を記入する。記入された送付用伝票１０１は荷物に貼られる。次に物流会社の集荷人が、所定の集荷場所で荷物を受け取り、各預かり所から回収した荷物を物流センターに集める。物流センターに集められた荷物１０３は、貼られている送付用伝票１０１の内容が物流管理サーバー１０２に登録され、バーコードと送付用伝票１０１とが対応づけされる。登録された荷物１０３はベルトコンベア上に載せられる。ベルトコンベアによりバーコード読取り装置１０５まで移動した荷物１０３は、バーコード読取り装置１０５で送付用伝票１０１のバーコードが読み取られる。バーコード読取り装置１０５は、先に物流管理サーバー１０２に登録された荷受人情報の地域情報を基に、その荷物が宛先の地域毎に設定されている所定の場所に行き着くように、バーコード読取り装置１０５以降のベルトコンベアを制御する。このようにして、宛先の地域別に集められた荷物は、配送用トラックに積込まれ、宛先に荷物が届けられる。

【０００８】さらに、配送用トラックで運ばれ、宛先に到着した荷物１１１（図１１）は、トラックから降ろされ、荷物に貼られた送付用伝票１１２のバーコードを携帯型バーコード読取り装置１１３が読取り、宛先に到着したという情報として蓄えられる。

【０００９】次に、ＰＯＳシステムについて述べる。ＰＯＳシステムの場合、商品に印刷されたバーコードをレジ担当者がバーコード読取り装置で読み取る。その結果、読取られた商品名、価格等の情報がレジスタに転送かつ表示され、その代金をレジにて支払うことにより、商品を購入することができる。

【００１０】次に、従来の無線通信管理システムとしてのチェックシステムについて説明する。

【００１１】図１２（ａ）、（ｂ）は従来のチェックシステムを示す構成図である。

【００１２】図１２において、１２１はドア開閉を制御するカード読取り装置、１２２は社員カードまたは会員証、１２３は商品、１２４は未購入商品に貼られた商品タグ、１２５は商品タグ１２４を検出するセンサである。

【００１３】以上のように構成されたチェックシステムについて、その動作を説明する。

【００１４】まず、カード読取り装置を利用したドア開閉システムについて図１２（ａ）を用いて説明する。社員または会員は、ドアのそばに設置されたカード読取り装置１２１に社員証または会員証１２２を挿入し、カード読取り装置１２１で読み取った情報が登録された情報と一致していれば、ドアが開く。

【００１５】次に、万引き防止システムについて説明する。商品１２３には予め商品タグ１２４が装着されている。そして、購入すれば、その装着された商品タグ１２４が外される。したがって、未購入の商品１２３を店外に持ち出そうとすると、店の出入口に設置されたセンサ１２５が商品タグ１２４を検出し、警告音を発する。

【００１６】

【発明が解決しようとする課題】しかしながら、従来の無線通信管理システムとしての物流システム、ＰＯＳシステム、チェックシステムでは、依然として人手が必要な場面が多く、自動化されているとは言い難く、その結果、人手が必要な工程において依然として大きなコスト、時間が必要であるという問題点を有していた。

【００１７】この無線通信管理システムでは、人手が必要な工程を大幅に削減してコスト低減と時間短縮を図ることが要求されている。

【００１８】本発明は、この要求を満たすため、人手が必要な工程を大幅に削減してコスト低減と時間短縮を図ることができる無線通信管理システムを提供することを目的とする。

【００１９】

【課題を解決するための手段】上記課題を達成するために本発明の無線通信管理システムは、荷物に配設されメモリを有する無線通信装置と、無線通信装置と無線通信を行うことが可能なアクセスポイント装置と、アクセスポイント装置と無線通信を行うことが可能でアクセスポイント装置を介して無線通信装置のメモリの内容を読み出すことができるパーソナルコンピュータと、電話回線等のネットワークとを有する構成を備えている。

【００２０】これにより、人手が必要な工程を大幅に削減してコスト低減と時間短縮を図ることができる無線通信管理システムが得られる。

【００２１】

【発明の実施の形態】本発明の請求項１に記載の無線通信管理システムは、荷物に配設されメモリを有する無線通信装置と、無線通信装置と無線通信を行うことが可能なアクセスポイント装置と、アクセスポイント装置と無線通信を行うことが可能でアクセスポイント装置を介して無線通信装置のメモリの内容を読み出すことができるパーソナルコンピュータと、電話回線等のネットワークとを有することとしたものである。

【００２２】この構成により、物流の取次所等にてパーソナルコンピュータと無線通信装置との間で、荷送人情報、荷受人情報、品名情報等の情報を通信し、無線通信装置のメモリに上記情報を記憶させ、この無線通信装置を荷物に取り付けることにより集荷作業を終了し、集荷された無線通信装置付き荷物を回収する物流センター内において、一定時間間隔でアクセスポイント装置はそのエリア内の無線通信装置を検出し、記憶された情報を受信し、自動荷分け工程を管理するパーソナルコンピュータに通知することにより、パーソナルコンピュータは、上記記憶された情報を基に自動的にベルトコンベアを制御し、所定の場所に分別収集し、並行して各荷物の予定配達時刻等の情報を荷受人にメール等により通知かつネットワーク（例えばインターネット）によるトラッキングシステムにその内容を反映させることができるという作用を有する。

【００２３】請求項２に記載の無線通信管理システムは、請求項１に記載の無線通信管理システムにおいて、荷物を配送するトラックを備え、トラックは、トラック用アクセスポイント装置と、トラック用パーソナルコンピュータと、位置情報を知らせるナビゲーションシステムと、携帯電話機とを有することとしたものである。

【００２４】この構成により、分別収集された無線通信装置付き荷物が輸送手段としてのトラックに積み込まれると、輸送手段に設置されているトラック用アクセスポイント装置と各無線通信装置付き荷物間で通信し、適切な輸送手段に積み込まれたか否かを自動荷分け工程を管理するパーソナルコンピュータに確認し、さらに配達完了時に輸送手段に設置されたトラック用パーソナルコンピュータに、配達完了通知を行い、その内容を一定時間毎にナビゲーションシステムによる位置情報と共に携帯

電話回線を利用してトラッキングシステム管理センターに送信し、その情報がトラッキングシステムに反映されることにより、物流の集荷、荷分け、配達までの全物流システムにおいて、自動化及びサービス性の向上が可能となるという作用を有する。

【００２５】請求項３に記載の無線通信管理システムは、請求項１に記載の無線通信管理システムにおいて、無線通信装置に代えて、社員カードに配設されメモリを有するカード用無線通信装置を有することとしたものである。

【００２６】この構成により、オフィスの出入口付近において、無線通信装置は、アクセスポイント装置を介して、パーソナルコンピュータと通信を行い、社員情報等の確認を行い、ドアの自動開閉制御を行うという作用を有する。

【００２７】請求項４に記載の無線通信管理システムは、請求項１に記載の無線通信管理システムにおいて、アクセスポイント装置は店の出入り口近傍に配設されたこととしたものである。

【００２８】この構成により、店の出入口付近において、商品に取り付けられた無線通信装置はアクセスポイントを介してパーソナルコンピュータと通信を行い、お客が持っている商品が購入済みの商品であることをチェックし、ドアの自動開閉制御を行うと共に、陳列商品に取り付けられた無線通信装置は定期的にアクセスポイント装置と通信することにより、陳列商品の在庫状況を逐次自動モニタ可能となり、陳列商品在庫管理の自動化が図れるという作用を有する。

【００２９】請求項５に記載の無線通信管理システムは、メモリを有するカード用無線通信装置が配設された社員カードと、社員カードの在・不在を検出する在・不在管理サーバーと、在・不在管理サーバーとの通信が可能でボイスメール機能を有するＰＢＸシステムと、カード用無線通信装置と無線通信を行うことが可能なアクセスポイント装置と、アクセスポイント装置と無線通信を行うことが可能なパーソナルコンピュータとを有することとしたものである。

【００３０】この構成により、オフィス等において、アクセスポイント装置は、ある社員に割り当てられたパーソナルコンピュータの電源ＯＮ／ＯＦＦ状態または通信エリア内に社員情報を持つ無線通信装置の在・不在を検出し、在・不在管理サーバーに特定社員の出社状況を通知することができるので、未出社社員当ての内線番号への電話があった場合、ボイスメール機能内蔵ＰＢＸシステムは、在・不在管理サーバーに出社状況を照会し、不在確認後音声ガイダンスによりその旨を伝え、必要があれば伝言メッセージを記憶可能であり、さらにアクセスポイント装置が複数台設置され、その社員が出社していると検出していれば、在・不在管理サーバーは社員カードをアクセスポイント装置を介して一定時間間隔で追跡検出し、その社員カードを所持した社員への電話があった場合、自動的にアクセスポイント装置近辺の電話に自動転送することができるという作用を有する。

【００３１】請求項６に記載の無線通信管理システムは、物流在庫管理を行う無線通信管理システムであって、荷物に配設されメモリを有する無線通信装置と、無線通信装置と無線通信を行うことが可能なアクセスポイント装置と、アクセスポイント装置と無線通信を行うことが可能でアクセスポイント装置を介して無線通信装置のメモリの内容を読み出すことができるパーソナルコンピュータとを有することとしたものである。

【００３２】この構成により、物流センターにおいて、物流在庫管理用のパーソナルコンピュータは、一定間隔でアクセスポイント装置を介して、荷物の在庫管理を各荷物に取り付けられた無線通信装置と荷物情報を通信することにより、自動かつ定期的に最新在庫の管理が可能になるという作用を有する。

【００３３】請求項７に記載の無線通信管理システムは、メモリを有しクリップにより荷物に取り付けることが可能なクリップ型無線通信装置と、メモリの内容の読出しとクリップ型無線通信装置のクリップの取外しが可能な自動情報読取り・取外し装置と、自動情報読取り・取外し装置との通信が可能なＰＯＳシステムとを有することとしたものである。

【００３４】この構成により、店のＰＯＳシステムにおいて、価格、品種等の個々の商品情報を予め無線通信装置のメモリに記憶させておき、お客が購入する際、自動情報読取り・取外し装置に入れると、自動情報読取り・取外し装置は、自動的にその商品に貼られた無線通信装置のメモリに記憶された商品情報を読み取り、ＰＯＳシステムにその内容を通知し、ＰＯＳシステムは合計金額を表示し、対応する金額が現金及びクレジット等により振り込まれたことを確認後、自動情報読取り・取外し装置に無線通信装置を取り外すよう指示し、決裁済み商品のみが自動情報読取り・取外し装置から出てくることによりレジの無人化が図れるという作用を有する。

【００３５】以下、本発明の実施の形態について、図１～図９を用いて説明する。

【００３６】（実施の形態１）図１は、本発明の実施の形態１による無線通信管理システムを構成する無線通信装置を示すブロック図である。

【００３７】図１において、１は外部機器からの入力を行う入力インターフェース部、２は情報の記憶をするメモリ、３は特定の送信用のプロトコル操作を行う送信プロトコル部、４は送信プロトコルに基づいて一定フレーム内にデータを構成する送信ベースバンド処理部、５は送信ベースバンド処理部４出力の送信ベースバンド信号に対して特定の変調を行う変調部、６は変調部５出力の変調信号に対して特定周波数にアップコンバート等を行う送信無線部、７は送信アンテナ、８は受信アンテナ、

９は受信アンテナ８で受信した受信信号を特定周波数へダウンコンバート等を行う受信無線部、１０は変調部５に対応した復調を行う復調部、１１は復調部１０出力の復調信号のフレームの中から受信データを取出す受信ベースバンド処理部、１２は受信ベースバンド処理部１１出力の受信データに対して受信用のプロトコル操作を行う受信プロトコル部、１３は受信したデータを外部機器に出力する出力インターフェース部である。

【００３８】以上のように構成された無線通信装置について、その動作を説明する。

【００３９】送信系統においては、外部機器からの送信データを入力インターフェース部１を介して入力するか、あるいはメモリ２からのデータを読み込み、送信プロトコル部３は、特定の送信用プロトコル操作を行う。送信プロトコル部３の出力を入力した送信ベースバンド処理部４は、送信プロトコルに基づいて一定フレーム内にデータを構成する。送信ベースバンド処理部４からの送信ベースバンド信号を入力し、変調部５は、特定の変調方式に従って変調を行い、変調信号を送信無線部６に出力する。変調信号を入力した送信無線部６は、その変調信号を特定周波数までアップコンバートし、送信アンテナ７を介して送信する。

【００４０】受信系統においては、受信アンテナ８を介して受信した受信信号を入力した受信無線部９は、特定周波数へダウンコンバートする。ダウンコンバートされた受信信号は復調部１０に入力され、復調部１０は、変調部５に対応した復調を行い、復調信号を受信ベースバンド処理部１１に出力する。受信ベースバンド処理部１１は、復調信号に対して、フレーム再生、フレーム内からのデータ抽出等を行い、受信データを出力する。受信プロトコル部１２は、受信ベースバンド処理部１１からの受信データに対して受信用プロトコロル処理を行い、出力インターフェース部１２を介して外部機器に出力するか、またはメモリ２にその内容を記憶する。

【００４１】上記無線通信装置を用いた無線通信管理システムとしての物流システムに関して、図２～図４を用いてその説明を行う。図２は本実施の形態１における情報書き込みの説明図であり、図３は本実施の形態１における自動荷先分別システムを示す構成図、図４は本実施の形態１におけるトラック内荷物管理システムを示す構成図である。

【００４２】図２において、２１は無線通信装置を内蔵したパーソナルコンピュータ（ＰＣ）、２２は物流を利用して送りたい荷物、２３は荷物２２に取り付けられた無線通信装置である。まず、利用者は、物流の取次所等に荷物２２を持って行き、荷送人情報、荷受人情報、品名情報等を担当者または自分がＰＣ２１に記入する。その記入された内容を、ＰＣ２１に内蔵された無線通信装置を介して、無線通信装置２３のメモリ２内に記憶し、その無線通信装置２３を荷物２２に取り付ける。荷物２２は各取次所等から集荷トラックにより物流センターに運ばれる。

【００４３】次に、物流センター内の自動荷分け工程に関する説明を図３により行う。

【００４４】図３において、３１は無線通信装置を内蔵しアクセスポイントとなるアクセスポイント装置、３２は集荷された荷物、３３は荷物に貼り付けられた無線通信装置、３４は自動荷分け工程を管理する無線通信装置内蔵のパーソナルコンピュータ（ＰＣ）、３５は電話回線等のネットワークである。アクセスポイント装置３１は常に一定時間間隔で通信エリア内に入った無線通信装置３３を探す。ＰＣ３４は、アクセスポイント装置３１と無線通信を行っており、アクセスポイント装置３１が検出した無線通信装置３３とＰＣ３４のデータベースとを随時照合している。未登録の無線通信装置３３が存在した場合、ＰＣ３４は、無線通信装置３３のメモリ２内に記憶されている荷送人情報、荷受人情報、品名情報等の情報を送信するようにアクセスポイント装置３１を介して要請し、その内容を受信すると、ＰＣ３４のデータベースに自動的に登録する。また、ＰＣ３４は、アクセスポイント装置３１を介して、データベースに登録された荷受人情報に従い、所定の行先地域毎の集荷場所に荷物３２が行き着くように、荷分けライン（ベルトコンベア）を制御する。ラインの自動制御により、自動的に所定の集荷場所に運ばれた各々の荷物３２は、配送トラックに積込まれる。

【００４５】ここで、荷物の荷送人情報、荷受人情報、品名情報、予定配達時間等の情報を電話回線等ネットワーク３５を用いてインターネットを用いたトラッキングシステムに反映させ、さらに荷送人情報、荷受人情報にメールアドレスが記入されていれば、直接荷送人及び荷受人に荷物の荷送人情報、荷受人情報、品名情報、予定配達時間等の荷受人に必要な情報を持ったメールを送信する。なお、これらトラッキングやメールを用いた情報提供サービスは、後の物流センター内の工程時間が明確となっていれば、図２の集荷場所のＰＣ２１から実施することも可能である。

【００４６】ここまでの物流センター内の物流工程において、人が必要な工程は、集荷トラックから荷物をライン上に載せ、配送トラックに荷物を積み込む工程のみとなり、物流センターのライン工程の無人化が図れる。

【００４７】さらに、物流センターで自動荷分けされて、配送トラック等に積込まれた荷物は、各荷先に配達される。この説明を図４により行う。

【００４８】図４において、４１は配送トラック内に設置された無線通信装置内蔵のアクセスポイント装置（トラック用アクセスポイント装置）、４２は荷物、４３は無線通信装置、４４はトラック内の荷物管理を行う無線通信装置内蔵のパーソナルコンピュータ（トラック用パーソナルコンピュータ）、４５は位置情報を知らせるナ

ビゲーションシステム、４６は携帯電話機である。

【００４９】図４において、まず、積み込まれた各荷物４２に取り付けられた無線通信装置４３は、アクセスポイント装置４１を介して、ＰＣ４４に荷受人情報等を送信する。積み込まれた全荷物の荷受人情報等を受信したＰＣ４４は、携帯電話機４６または無線通信装置を介して、図３の物流センター内のＰＣ３４に対して、積み込まれた荷物の確認を自動的に実施する。これは、全ての荷物が間違いなく目的の配送トラックに積み込まれたことを確認するためである。次に、ＰＣ４４は、ナビゲーションシステム４５と連動し、最適な配達コースを割り出し、ナビゲーションシステム４５上に表示する。配送中、一定時間毎にナビゲーションシステムによる配送トラックの現在位置情報を携帯電話機４６を介して通知する。この結果、インターネット等を用いた非常に精度の高いトラッキングシステムが自動的に構築可能となる。また、荷先に配達された荷物に貼り付けられた無線通信装置４３は、荷先に届けられた時点で配達人により取り外される。その取り外したことを検知したＰＣ４４は、その旨を携帯電話機４６を介して物流センターに通知することにより、荷物を荷先リストから除外し、届け済みリストに移行する。なお、取り外された無線通信装置４３は、再度、物流の取次所等で情報を上書きすることにより、再利用可能である。

【００５０】また、荷物の荷送人情報、荷受人情報、品名情報、配達時間等の必要な情報を持ったメールを受信した荷受人は、配達時間に荷先で不在であることが事前に分かっていれば、その旨のメール返信を行い、可能であれば荷受人により受取場所を変更し、その変更された場所に配達することが可能となる。さらに、なま物、割れ物等荷物の種類による異なる配送方法も自動的に分別可能となる。

【００５１】このように、物流の集荷、物流センター内の工程、配達までの全物流システムにおいて、自動化及びサービス向上が可能となる。

【００５２】以上のように本実施の形態によれば、荷物に配設されメモリ２を有する無線通信装置３３と、無線通信装置３３と無線通信を行うことが可能なアクセスポイント装置３１と、アクセスポイント装置３１と無線通信を行うことが可能でアクセスポイント装置３１を介して無線通信装置３３のメモリ２の内容を読み出すことができるパーソナルコンピュータ３４と、電話回線等のネットワーク３５とを有することにより、物流の取次所等にてパーソナルコンピュータ３４と無線通信装置３３との間で、荷送人情報、荷受人情報、品名情報等の情報を通信し、無線通信装置３３のメモリ２に上記情報を記憶させ、この無線通信装置３３を荷物に取り付けることにより集荷作業を終了し、集荷された無線通信装置付き荷物３２を回収する物流センター内において、一定時間間隔でアクセスポイント装置３１はそのエリア内の無線通信装置３３を検出し、記憶された情報を受信し、自動荷分け工程を管理するパーソナルコンピュータ３４に通知することにより、パーソナルコンピュータ３４は、上記記憶された情報を基に自動的にベルトコンベアを制御し、所定の場所に分別収集し、並行して各荷物３２の予定配達時刻等の情報を荷受人にメール等により通知かつネットワーク（例えばインターネット）によるトラッキングシステムにその内容を反映させることができる。

【００５３】また、荷物を配送するトラックを備え、トラックは、トラック用アクセスポイント装置４１と、トラック用パーソナルコンピュータ４４と、位置情報を知らせるナビゲーションシステム４５と、携帯電話機４６とを有することにより、分別収集された無線通信装置付き荷物４２が輸送手段としてのトラックに積み込まれると、輸送手段に設置されているトラック用アクセスポイント装置４１と各無線通信装置付き荷物４２との間で通信し、適切な輸送手段に積み込まれたか否かを自動荷分け工程を管理するパーソナルコンピュータ４４に確認し、さらに配達完了時に輸送手段に設置されたトラック用パーソナルコンピュータ４４に、配達完了通知を行い、その内容を一定時間毎にナビゲーションシステム４５による位置情報と共に携帯電話回線を利用してトラッキングシステム管理センターに送信し、その情報がトラッキングシステムに反映されることにより、物流の集荷、荷分け、配達までの全物流システムにおいて、自動化及びサービス性の向上が可能となる。

【００５４】（実施の形態２）図５は、本発明の実施の形態２による無線通信管理システムとしてのチェックシステムを示す構成図である。本実施の形態における無線通信装置の構成は実施の形態１と同様、図１の構成である。

【００５５】図５において、５１は無線通信装置を内蔵したアクセスポイント装置、５２は無線通信装置を内蔵したパーソナルコンピュータ（ＰＣ）またはＰＯＳシステム、５３は商品、５４は図１の構成の無線通信装置、５５はメモリを有する無線通信装置を内蔵した社員カードまたは会員証である。

【００５６】図５に示すように、会社、オフィス、コンビニエンスストア、スーパーマーケットの出入口等にアクセスポイント装置５１を設置しておく。このアクセスポイント装置５１の通信エリア内に入った無線通信装置５４や社員カード５５は、アクセスポイント装置５１を介してＰＣまたはＰＯＳシステム５２によりチェックされ、ドアの自動開閉制御を行う。

【００５７】会社、オフィス等であれば、チェックされる内容は、出入りしようとしている人の社員情報である。この情報は社員カード５５のメモリ内に予め記憶させておく。この社員情報を、アクセスポイント装置５１を介してＰＣ５２でチェックすることにより、ドアの開閉を自動的に行うことができるようになる。

【００５８】また、コンビニエンスストア、スーパーマーケット等であれば、各商品に無線通信装置を容易に取外し不可能なように取付けておく。そして、購入後、無線通信装置はレジの取外し装置にて取外される。未購入品が店外に持ち出されようとすれば、出入口の付近に設置された無線通信装置内蔵アクセスポイント装置５１が検出し、ドアを開けないように制御し、さらに店員に警告を通知し、万引き防止を行う。また、陳列商品に取付けられた無線通信装置５４は定期的に、無線通信装置内蔵アクセスポイント装置５１と通信することにより、陳列商品の在庫状況を逐次自動モニタすることができ、陳列商品在庫管理の自動化が図れる。

【００５９】以上のように本実施の形態によれば、アクセスポイント装置５１に近づくだけで自動的にドアを開閉するため、社員カードをカード読取り装置等に挿入する等の作業が発生しない。また、基本的に同一システムを流用し、無線通信装置５４を商品に取付けておくことにより、万引き防止が可能となる。

【００６０】（実施の形態３）図６は本発明の実施の形態３による無線通信管理システムとしての在・不在管理システムを示す構成図である。本実施の形態における無線通信装置の構成は実施の形態１と同様、図１に示す構成である。

【００６１】図６において、６１はボイスメール機能を内蔵したＰＢＸシステム、６２は在・不在管理サーバー、６３は電話機、６４は無線通信装置を内蔵したアクセスポイント装置、６５は無線通信装置を内蔵したパーソナルコンピュータ（ＰＣ）、６６はメモリを有する無線通信装置を内蔵した社員カードである。

【００６２】図６において、構成要素６１～６６が例えばオフィスに配置されている場合、アクセスポイント装置６４は、ある社員に割り当てられたＰＣ６５の電源がオンかオフか、または通信エリア内に社員カード６６が存在するか否かを検出し、在・不在管理サーバー６２に特定社員の出社状況を通知する。未出社社員当ての内線番号への電話があった場合、ボイスメール機能を内蔵したＰＢＸシステム６１は、在・不在管理サーバー６２に出社状況を照会し、不在確認後に音声ガイダンスによりその旨を伝え、必要があれば伝言メッセージを記憶する。さらに、アクセスポイント装置６４が複数台設置されているようなオフィスにおいては、在・不在管理サーバー６２は、社員カード６６をアクセスポイント装置６４を介して一定時間間隔で追跡検出し、その社員カード６６を所持した社員への電話があった場合、自動的にアクセスポイント装置６４近辺の電話に転送することができる。これにより、その社員はわざわざ自分の机まで電話を取りに戻る必要がなくなる。

【００６３】以上のように本実施の形態によれば、メモリを有するカード用無線通信装置が配設された社員カード６６と、社員カード６６の在・不在を検出する在・不在管理サーバー６２と、在・不在管理サーバー６２との通信が可能でボイスメール機能を有するＰＢＸシステム６１と、カード用無線通信装置と無線通信を行うことが可能なアクセスポイント装置６４と、アクセスポイント装置６４と無線通信を行うことが可能なパーソナルコンピュータ６５とを有することにより、オフィス等において、アクセスポイント装置６４は、ある社員に割り当てられたパーソナルコンピュータ６５の電源ＯＮ／ＯＦＦ状態または通信エリア内に社員情報を持つ無線通信装置の在・不在を検出し、在・不在管理サーバー６２に特定社員の出社状況を通知することができるので、未出社社員当ての内線番号への電話があった場合、ボイスメール機能内蔵ＰＢＸシステム６１は、在・不在管理サーバー６２に出社状況を照会し、不在確認後音声ガイダンスによりその旨を伝え、必要があれば伝言メッセージを記憶可能であり、さらにアクセスポイント装置６４が複数台設置され、その社員が出社していると検出していれば、在・不在管理サーバー６２は社員カード６６をアクセスポイント装置６４を介して一定時間間隔で追跡検出し、その社員カード６６を所持した社員への電話があった場合、自動的にアクセスポイント装置６４近辺の電話に自動転送することができる。

【００６４】（実施の形態４）図７は本発明の実施の形態４による無線通信管理システムとしての物流在庫管理システムを示す構成図である。本実施の形態における無線通信装置の構成は実施の形態１と同様、図１に示す構成である。

【００６５】図７において、７１は無線通信装置を内蔵したアクセスポイント装置、７２は無線通信装置を内蔵した物流在庫管理用のパーソナルコンピュータ（ＰＣ）、７３は荷物、７４は図１と同様の構成の無線通信装置である。

【００６６】パーソナルコンピュータ７２は、各荷物に貼られた無線通信装置７４とアクセスポイント装置７１とを自動的に一定時間間隔で通信させ、その内容をアクセスポイント装置７１を介して受信することにより、自動的に物流センターの在庫管理が出来るものである。つまり、わざわざ在庫棚等まで担当者が出向き、ハンディターミナル等を利用して在庫管理を行う必要がなく、自動的に最新の在庫状況が分かるものである。

【００６７】以上のように本実施の形態によれば、荷物７３に配設されメモリ２を有する無線通信装置７４と、無線通信装置７４と無線通信を行うことが可能なアクセスポイント装置７１と、アクセスポイント装置７１と無線通信を行うことが可能でアクセスポイント装置７１を介して無線通信装置７４のメモリ２の内容を読み出すことができるパーソナルコンピュータ７２とを有することにより、物流センターにおいて、物流在庫管理用のパーソナルコンピュータ７２は、一定間隔でアクセスポイント装置７１を介して、荷物の在庫管理を各荷物に取り付

けられた無線通信装置７４と荷物情報を通信することにより、自動かつ定期的に最新在庫の管理が可能になる。

【００６８】（実施の形態５）図８、図９は本発明の実施の形態５による無線通信管理システムとしてのＰＯＳシステムを示す構成図である。本実施の形態における無線通信装置の構成は実施の形態１と同様、図１に示す構成である。

【００６９】図８において、８１はＰＯＳシステム、８２は商品、８３は商品８２を入れたビニール袋に取り付けられたクリップ型無線通信装置、８４はクリップ型無線通信装置８３のメモリから無線通信により価格、品種等の情報を受信し、ＰＯＳシステム８１に通知後、自動的にクリップ型無線通信装置８３を取り外す自動情報読取り・取外し装置である。また図９において、９１は商品、９２は商品９１を入れるための梱包（ビニール袋、ラップ、箱等）、９３は梱包９２に取り付けるクリップ型無線通信装置、９４はそのクリップ型無線通信装置９３を横から見たもの、９５はクリップ型無線通信装置９４を取付け可能なようにクリップ取付け用スペース９６がある商品である。

【００７０】コンビニエンスストアやスーパーマーケット等の店頭に陳列する前に、図９のように、クリップ取付け用スペース９６がある商品９５以外の商品９１は梱包９２に入れる。例えば、その梱包がビニール袋の場合、商品９１を入れた後、ビニール袋の口にクリップ型無線通信装置９４を取り付けて、クリップ型無線通信装置９３のようにクリップ部分を閉じ、ビニール袋の口を閉じる。また、クリップ取付け用スペース９６がある商品９５の場合、そのクリップ取付け用スペース９６にそのままクリップ型無線通信装置９３を取り付ける。なお、価格、品種等の個々の商品情報をクリップ型無線通信装置９３のメモリに記憶させておく。クリップ型無線通信装置９３は、一旦取り付けられると、決められたコマンドを受信しない限り、クリップ部分が開かず、容易にクリップ型無線通信装置９３を取り外すことが不可能である。このようにして、クリップ型無線通信装置９３が取り付けられた商品が店頭に陳列され、お客様が購入しようとレジに持ってくる。その後を、図８を用いて説明する。

【００７１】図８において、レジのベルトコンベアに並べられた商品８２は順次、自動情報読取り・取外し装置８４の中に入る。自動情報読取り・取外し装置８４は、その中に入った商品８２に取付けられたクリップ型無線通信装置８３を呼出し、クリップ型無線通信装置８３のメモリに記憶された商品情報を読み取り、ＰＯＳシステム８１にその内容を通知する。その後、自動情報読取り・取外し装置８４は、クリップ型無線通信装置８３を取り外すために、決められたコマンドを送信する。そのコマンドを受信したクリップ型無線通信装置８３はクリップ部分が開き、自動情報読取り・取外し装置８４の底に落ちる。落ちたクリップ型無線通信装置８３は、自動情報読取り・取外し装置８４の底部分に溜り、価格、品種等の個々の商品情報を上書きして再利用可能である。最後の商品が自動情報読取り・取外し装置８４から出てくると、お客は合計金額を支払う。このようにして、レジの無人化が図れる。

【００７２】以上のように本実施の形態によれば、メモリを有しクリップにより荷物に取り付けることが可能なクリップ型無線通信装置８３と、メモリの内容の読出しとクリップ型無線通信装置８３のクリップの取外しが可能な自動情報読取り・取外し装置８４と、自動情報読取り・取外し装置８４との通信が可能なＰＯＳシステム８１とを有することにより、店のＰＯＳシステムにおいて、価格、品種等の個々の商品情報を予め無線通信装置のメモリに記憶させておき、お客が購入する際、自動情報読取り・取外し装置８４に入れると、自動情報読取り・取外し装置８４は、自動的にその商品に貼られたクリップ型無線通信装置８３のメモリに記憶された商品情報を読み取り、ＰＯＳシステム８１にその内容を通知し、ＰＯＳシステム８１は合計金額を表示し、対応する金額が現金及びクレジット等により振り込まれたことを確認後、自動情報読取り・取外し装置８４にクリップ型無線通信装置８３を取り外すよう指示し、決裁済み商品のみが自動情報読取り・取外し装置８４から出てくることによりレジの無人化を図ることができる。

【００７３】

【発明の効果】以上説明したように本発明の請求項１に記載の無線通信管理システムによれば、荷物に配設されメモリを有する無線通信装置と、無線通信装置と無線通信を行うことが可能なアクセスポイント装置と、アクセスポイント装置と無線通信を行うことが可能でアクセスポイント装置を介して無線通信装置のメモリの内容を読み出すことができるパーソナルコンピュータと、電話回線等のネットワークとを有することにより、物流の取次所等にてパーソナルコンピュータと無線通信装置との間で、荷送人情報、荷受人情報、品名情報等の情報を通信し、無線通信装置のメモリに上記情報を記憶させ、この無線通信装置を荷物に取り付けることにより集荷作業を終了し、集荷された無線通信装置付き荷物を回収する物流センター内において、一定時間間隔でアクセスポイント装置はそのエリア内の無線通信装置を検出し、記憶された情報を受信し、自動荷分け工程を管理するパーソナルコンピュータに通知することにより、パーソナルコンピュータは、上記記憶された情報を基に自動的にベルトコンベアを制御し、所定の場所に分別収集し、並行して各荷物の予定配達時刻等の情報を荷受人にメール等により通知かつネットワーク（例えばインターネット）によるトラッキングシステムにその内容を反映させることができ、人手が必要な工程を大幅に削減してコスト低減とシステム運用の時間短縮を図ることができるという有利

な効果が得られる。

【００７４】請求項２に記載の無線通信管理システムによれば、請求項１に記載の無線通信管理システムにおいて、荷物を配送するトラックを備え、トラックは、トラック用アクセスポイント装置と、トラック用パーソナルコンピュータと、位置情報を知らせるナビゲーションシステムと、携帯電話機とを有することにより、分別収集された無線通信装置付き荷物が輸送手段としてのトラックに積み込まれると、輸送手段に設置されているトラック用アクセスポイント装置と各無線通信装置付き荷物間で通信し、適切な輸送手段に積み込まれたか否かを自動荷分け工程を管理するパーソナルコンピュータに確認し、さらに配達完了時に輸送手段に設置されたトラック用パーソナルコンピュータに、配達完了通知を行い、その内容を一定時間毎にナビゲーションシステムによる位置情報と共に携帯電話回線を利用してトラッキングシステム管理センターに送信し、その情報がトラッキングシステムに反映されることにより、物流の集荷、荷分け、配達までの全物流システムにおいて、自動化及びサービス性の向上が可能となるという有利な効果が得られる。

【００７５】請求項３に記載の無線通信管理システムによれば、請求項１に記載の無線通信管理システムにおいて、無線通信装置に代えて、社員カードに配設されメモリを有するカード用無線通信装置を有することにより、オフィスの出入口付近において、無線通信装置は、アクセスポイント装置を介して、パーソナルコンピュータと通信を行い、社員情報等の確認を行い、ドアの自動開閉制御を行うことができるという有利な効果が得られる。

【００７６】請求項４に記載の無線通信管理システムによれば、請求項１に記載の無線通信管理システムにおいて、アクセスポイント装置は店の出入り口近傍に配設されたことにより、店の出入口付近において、商品に取り付けられた無線通信装置はアクセスポイントを介してパーソナルコンピュータと通信を行い、お客が持っている商品が購入済みの商品であることをチェックし、ドアの自動開閉制御を行うことができ、万引きを防止することができると共に、陳列商品に取り付けられた無線通信装置は定期的にアクセスポイント装置と通信することにより、陳列商品の在庫状況を逐次自動モニタすることができるので、陳列商品在庫管理の自動化を図ることができるという有利な効果が得られる。

【００７７】請求項５に記載の無線通信管理システムによれば、メモリを有するカード用無線通信装置が配設された社員カードと、社員カードの在・不在を検出する在・不在管理サーバーと、在・不在管理サーバーとの通信が可能でボイスメール機能を有するＰＢＸシステムと、カード用無線通信装置と無線通信を行うことが可能なアクセスポイント装置と、アクセスポイント装置と無線通信を行うことが可能なパーソナルコンピュータとを有することにより、オフィス等において、アクセスポイント装置は、ある社員に割り当てられたパーソナルコンピュータの電源ＯＮ／ＯＦＦ状態または通信エリア内に社員情報を持つ無線通信装置の在・不在を検出し、在・不在管理サーバーに特定社員の出社状況を通知することができるので、未出社社員当ての内線番号への電話があった場合、ボイスメール機能内蔵ＰＢＸシステムによれば、在・不在管理サーバーに出社状況を照会し、不在確認後音声ガイダンスによりその旨を伝え、必要があれば伝言メッセージを記憶可能であり、さらにアクセスポイント装置が複数台設置され、その社員が出社していると検出していれば、在・不在管理サーバーは社員カードをアクセスポイント装置を介して一定時間間隔で追跡検出し、その社員カードを所持した社員への電話があった場合、自動的にアクセスポイント装置近辺の電話に自動転送することができるという有利な効果が得られる。

【００７８】請求項６に記載の無線通信管理システムによれば、物流在庫管理を行う無線通信管理システムであって、荷物に配設されメモリを有する無線通信装置と、無線通信装置と無線通信を行うことが可能なアクセスポイント装置と、アクセスポイント装置と無線通信を行うことが可能でアクセスポイント装置を介して無線通信装置のメモリの内容を読み出すことができるパーソナルコンピュータとを有することにより、物流センターにおいて、物流在庫管理用のパーソナルコンピュータは、一定間隔でアクセスポイント装置を介して、荷物の在庫管理を各荷物に取り付けられた無線通信装置と荷物情報を通信することにより、自動かつ定期的に最新在庫の管理が可能になるという有利な効果が得られる。

【００７９】請求項７に記載の無線通信管理システムによれば、メモリを有しクリップにより荷物に取り付けることが可能なクリップ型無線通信装置と、メモリの内容の読出しとクリップ型無線通信装置のクリップの取外しが可能な自動情報読取り・取外し装置と、自動情報読取り・取外し装置との通信が可能なＰＯＳシステムとを有することにより、店のＰＯＳシステムにおいて、価格、品種等の個々の商品情報を予め無線通信装置のメモリに記憶させておき、お客が購入する際、自動情報読取り・取外し装置に入れると、自動情報読取り・取外し装置は、自動的にその商品に貼られた無線通信装置のメモリに記憶された商品情報を読み取り、ＰＯＳシステムにその内容を通知し、ＰＯＳシステムは合計金額を表示し、対応する金額が現金及びクレジット等により振り込まれたことを確認後、自動情報読取り・取外し装置に無線通信装置を取り外すよう指示し、決裁済み商品のみが自動情報読取り・取外し装置から出てくることによりレジの無人化が図れるという有利な効果が得られる。

【図面の簡単な説明】

【図１】本発明の実施の形態１～５による無線通信管理システムを構成する無線通信装置を示すブロック図

【図２】本発明の実施の形態１における情報書き込みの

説明図

【図３】本発明の実施の形態１における自動荷先分別システムを示す構成図

【図４】本発明の実施の形態１におけるトラック内荷物管理システムを示す構成図

【図５】本発明の実施の形態２による無線通信管理システムとしてのチェックシステムを示す構成図

【図６】本発明の実施の形態３による無線通信管理システムとしての在・不在管理システムを示す構成図

【図７】本発明の実施の形態４による無線通信管理システムとしての物流在庫管理システムを示す構成図

【図８】本発明の実施の形態５による無線通信管理システムとしてのＰＯＳシステムを示す構成図

【図９】本発明の実施の形態５による無線通信管理システムとしてのＰＯＳシステムを示す構成図

【図１０】バーコードを利用した従来の無線通信管理システムとしての物流システムを示す構成図

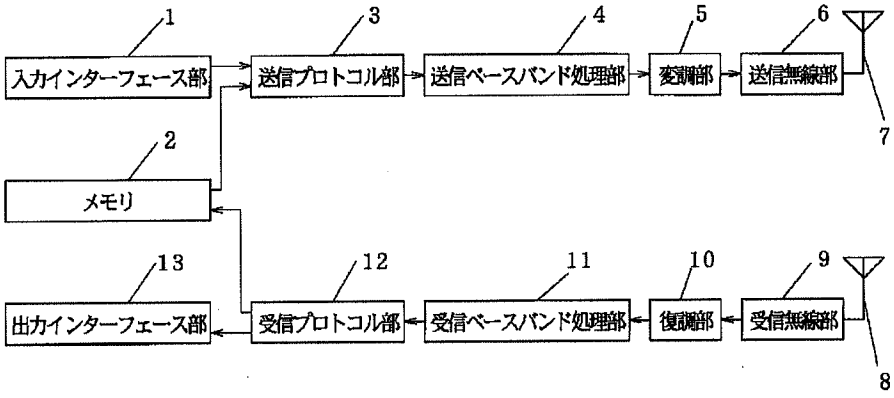
【図１１】バーコードを利用した従来の無線通信管理システムとしての物流システムを示す構成図

【図１２】（ａ）従来のチェックシステムを示す構成図
（ｂ）従来のチェックシステムを示す構成図

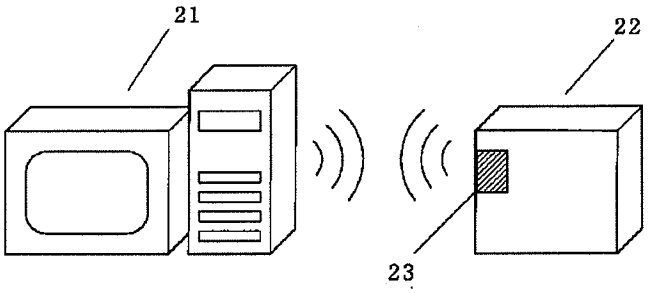
【符号の説明】

１　入力インターフェース部
２　メモリ
３　送信プロトコル部
４　送信ベースバンド処理部
５　変調部
６　送信無線部
７　送信アンテナ
８　受信アンテナ
９　受信無線部
１０　復調部
１１　受信ベースバンド処理部
１２　受信プロトコル部
１３　出力インターフェース部
２１、３４、４４、５２、６５、７２　パーソナルコンピュータ（ＰＣ）
２２、３２、４２、７３　荷物
２３、３３、４３、５４、７４　無線通信装置
３１、４１、５１、６４、７１　アクセスポイント装置
３５　ネットワーク
４５　ナビゲーションシステム
４６　携帯電話機
５３、８２、９１、９５　商品
５５　社員カードまたは会員証
６１　ＰＢＸシステム
６２　在・不在管理サーバー
６３　電話機
６６　社員カード
８１　ＰＯＳシステム
８３、９３、９４　クリップ型無線通信装置
８４　自動情報読取り・取外し装置
９２　梱包
９６　クリップ取付け用スペース

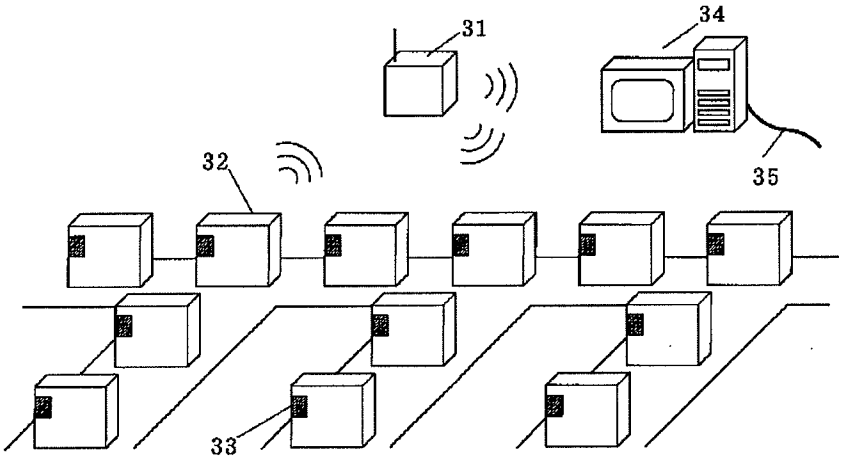
【図１】



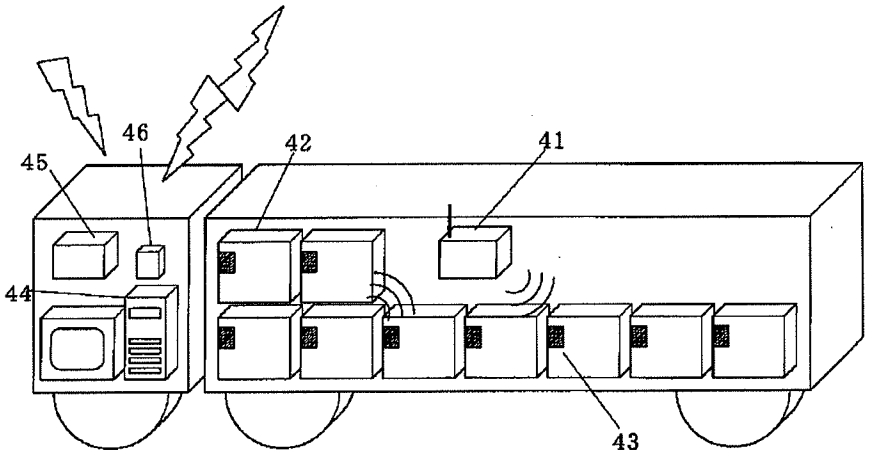
【図２】



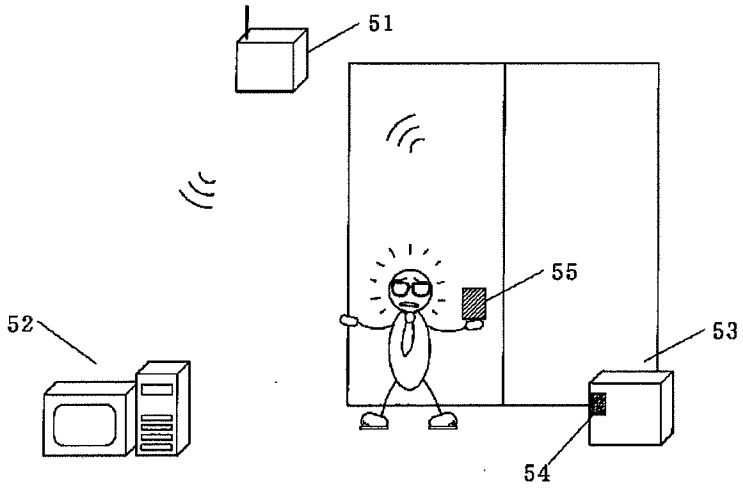
【図３】



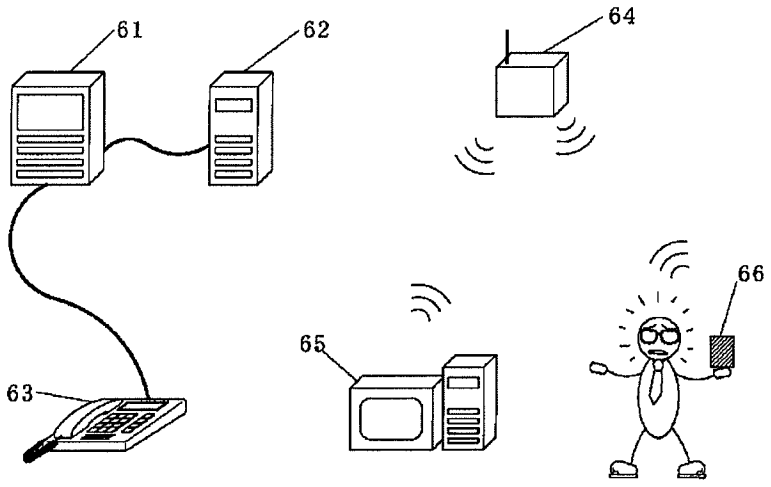
【図４】



【図５】



【図６】



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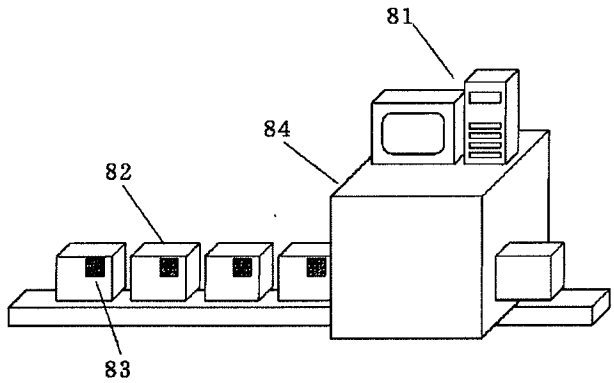

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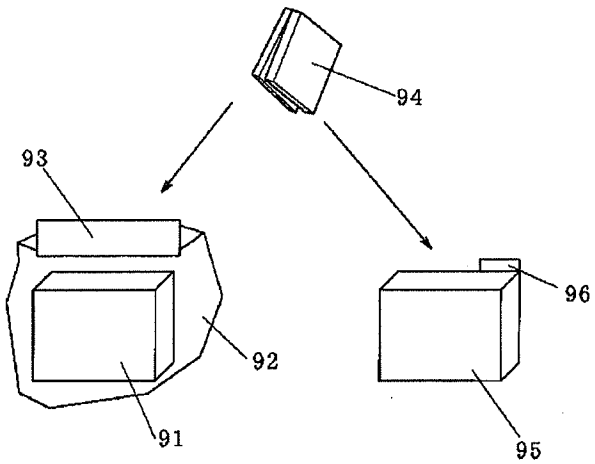

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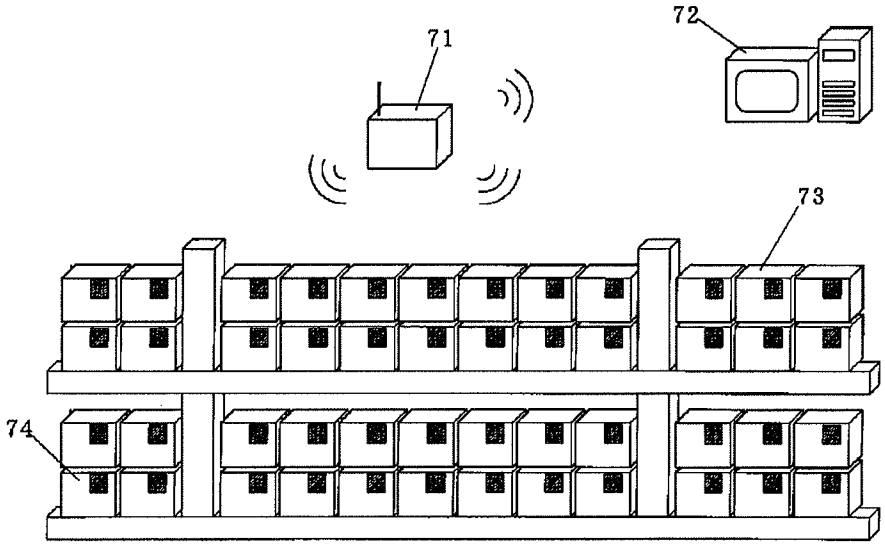
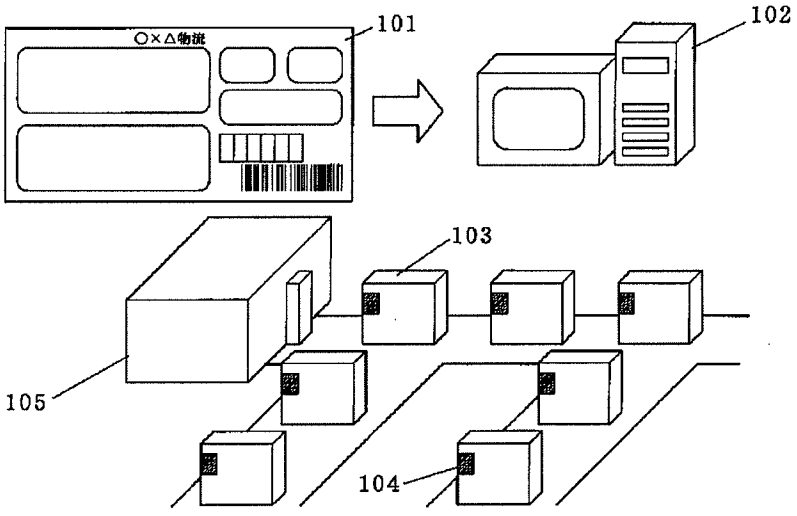
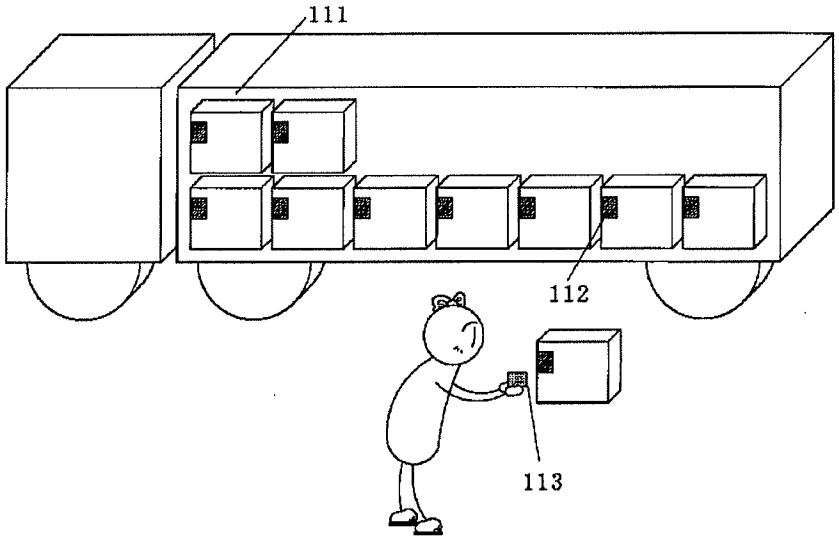


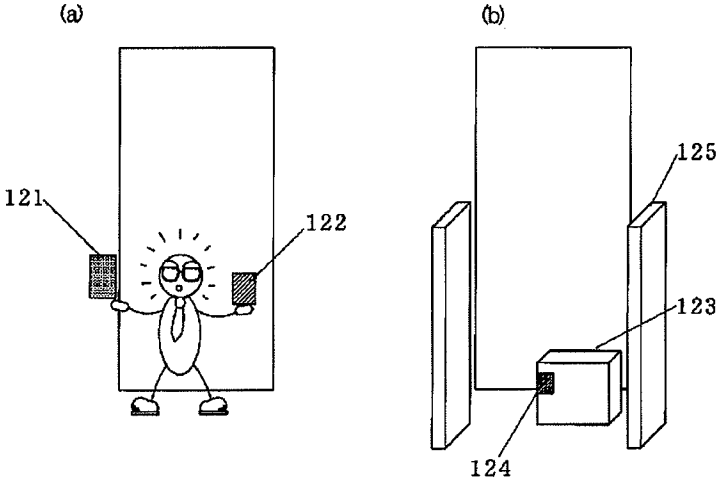
【図１０】



【図１１】



【図１２】



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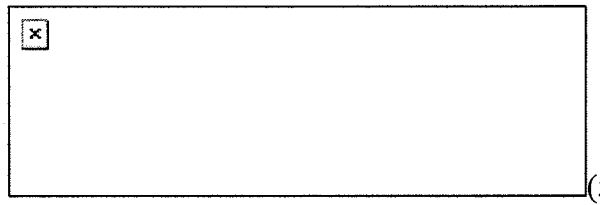
(22)Date of filing : **19.12.2000**

(71)Applicant : **TOSHIBA CORP**

(72)Inventor : **KANETANI SUNAO**

(54) SYSTEM FOR SEARCHING FOR PASSENGER IN AIRPORT



(57)Abstract:

PROBLEM TO BE SOLVED: To provide an intra-airport passenger searching system for helping search for a passenger who does not appear at the boarding gate at a scheduled time.

SOLUTION: This intra-airport passenger searching system is provided with a plurality of radio sensing devices (11 to 1n) which are arranged in each zone in the airport, detect a radio tag signal transmitted from a radio tag attached to a boarding ticket each time the passenger carrying the boarding ticket moves the zone and transmit a radio tag ID included in the radio tag signal together with a zone ID attached to the zone and detection time information, a passenger managing device (30) which receives the radio tag ID, the zone ID and the detection time information transmitted from each radio sensing device and has a database (31) for storing those pieces of received information, and a passenger searching terminal (41) which retrieves the database by using the radio tag ID of the radio tag attached to the boarding ticket carried by the passenger being a search object as a retrieval key and displays the zone in which the passenger of the search object finally drops in the airport together with the time information.

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（P2002－183261A）
(43)公開日　平成14年６月28日(2002.6.28)

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	１７２		１７２
Ｇ０７Ｂ　11/00	５０１	Ｇ０７Ｂ　11/00	５０１

審査請求　未請求　請求項の数４　ＯＬ　（全 3 頁）

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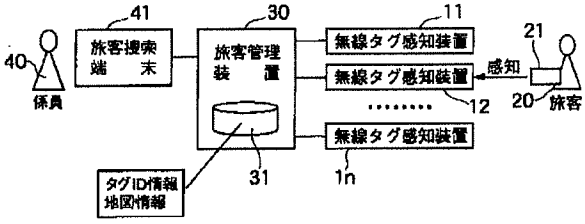
弁理士　佐藤　一雄　（外３名）

(54)【発明の名称】　空港内旅客捜索装置

(57)【要約】
【課題】　定刻になっても搭乗ゲートに現れないような旅客の捜索を支援する空港内旅客捜索装置を提供する。
【解決手段】　本発明の空港内旅客捜索装置は、空港内の各ゾーンごとに配置され、搭乗券を所持した旅客がゾーンを移動する度ごとに、搭乗券に付された無線タグから発信される無線タグ信号を感知し、それに含まれる無線タグＩＤをゾーンに付されたゾーンＩＤおよび感知時刻情報と共に送信する複数の無線感知装置（１１～１ｎ）と、各無線感知装置から送信された無線タグＩＤ、ゾーンＩＤおよび感知時刻情報を受信し、それらの受信情報を蓄積するデータベース（３１）を有する旅客管理装置（３０）と、捜索対象の旅客が所持している搭乗券に付された無線タグの無線タグＩＤを検索キーとしてデータベースを検索し、捜索対象の旅客が空港内で最終的に立寄ったゾーンを時刻情報と共に表示する旅客捜索端末（４１）とを備える。



【特許請求の範囲】
【請求項１】空港内を複数のゾーンに区分したときの各ゾーンごとに配置され、搭乗券を所持した旅客が前記ゾーンを移動する度ごとに、旅客が所持する搭乗券に付された無線タグから発信される無線タグ信号を感知し、その無線タグ信号に含まれる無線タグＩＤをゾーンに付されたゾーンＩＤおよび感知時刻情報と共に送信する複数の無線感知装置と、各無線感知装置から送信された無線タグＩＤ、ゾーンＩＤおよび感知時刻情報を受信し、それらの受信情報を蓄積するデータベースを有する旅客管理装置と、捜索対象の旅客が所持している搭乗券に付された無線タグの無線タグＩＤを検索キーとして前記旅客管理装置を介して前記データベースを検索し、前記捜索対象の旅客が空港内で最終的に立寄ったゾーンを前記時刻情報と共に表示する旅客捜索端末とを備えたことを特徴とする空港内旅客捜索装置。
【請求項２】請求項１に記載の空港内旅客捜索装置において、前記旅客捜索端末は捜索対象の旅客が空港内でたどった足取りをゾーン単位に降順で表示することを特徴とする空港内旅客捜索装置。
【請求項３】請求項１または２に記載の空港内旅客捜索装置において、前記無線タグは搭乗券とは別体に構成され、搭乗券に添付された形で備えられていることを特徴とする空港内旅客捜索装置。
【請求項４】請求項１または２に記載の空港内旅客捜索装置において、前記無線タグは搭乗券に内蔵されていることを特徴とする空港内旅客捜索装置。
【発明の詳細な説明】
【０００１】
【発明の属する技術分野】本発明は搭乗券を所有する旅客を空港内で捜索するための空港内旅客捜索装置に関する。
【０００２】
【従来の技術】空港内において航空会社のカウンタで搭乗手続きを終えた旅客が出発時刻間際になっても搭乗ゲートに現れない場合、従来は館内放送によって旅客呼出しをしたり、航空会社の係員が旅客の名前を呼びながら空港内を動き回ったりして探すのが一般的である。空港内は一般に探す範囲・場所が広く、捜索対象の旅客がどこに居るのか、簡単には分らないことが多い。このような状況のもとでは、係員の負担が大きく、捜索にも時間がかかり、極端な場合には航空機が定刻に出発できないことさえある。
【０００３】
【発明が解決しようとする課題】したがって本発明は、航空機への搭乗に不慣れ等の理由で定刻になっても搭乗ゲートに現れないような旅客の捜索を支援する空港内旅客捜索装置を提供することを目的とする。
【０００４】
【課題を解決するための手段】上記目的を達成するために、請求項１に係る発明の空港内旅客捜索装置は、空港内を複数のゾーンに区分したときの各ゾーンごとに配置され、搭乗券を所持した旅客がゾーンを移動する度ごとに、旅客が所持する搭乗券に付された無線タグから発信される無線タグ信号を感知し、その無線タグ信号に含まれる無線タグＩＤをゾーンに付されたゾーンＩＤおよび感知時刻情報と共に送信する複数の無線感知装置と、各無線感知装置から送信された無線タグＩＤ、ゾーンＩＤおよび感知時刻情報を受信し、それらの受信情報を蓄積するデータベースを有する旅客管理装置と、捜索対象の旅客が所持している搭乗券に付された無線タグの無線タグＩＤを検索キーとして旅客管理装置を介してデータベースを検索し、捜索対象の旅客が空港内で最終的に立寄ったゾーンを時刻情報と共に表示する旅客捜索端末とを備えたことを特徴とする。
【０００５】請求項２に係る発明は、請求項１に記載の空港内旅客捜索装置において、旅客捜索端末は捜索対象の旅客が空港内でたどった足取りをゾーン単位に降順で表示することを特徴とする。
【０００６】請求項３に係る発明は、請求項１または２に記載の空港内旅客捜索装置において、無線タグは搭乗券とは別体に構成され、搭乗券に添付された形で備えられていることを特徴とする。
【０００７】請求項４に係る発明は、請求項１または２に記載の空港内旅客捜索装置において、無線タグは搭乗券に内蔵されていることを特徴とする。
【０００８】
【発明の実施の形態】図１は、本発明による空港内旅客捜索装置の一実施形態を示すブロック図である。空港内は旅客捜索に便利なように適当数のゾーンに分割し、各ゾーンごとに無線タグ感知装置１１，１２，１３，・・・，１ｎを配設している。これらの無線タグ感知装置はそれぞれが設置されている感知ゾーンを特定するためのゾーンＩＤを持っている。ゾーンＩＤは、空港内のゾーン分割数に応じて、例えばＺＯＮＥ００１，ＺＯＮＥ００２，・・・のように割当てられる。旅客２０は予め入手している航空券を持って空港にチェックインし、航空券を搭乗券（ボーディング・パス）２１と引き換える。この搭乗券２１には本発明に従い無線タグが付されている。無線タグは、旅客２０が搭乗券２１を入手した後、旅客ＩＤすなわち固有の無線タグＩＤを含む無線タグ信号を発信し、以後、旅客が搭乗ゲートを通過する時まで発信し続ける。無線タグは搭乗券２１とは別体に構成し、それを搭乗券２１に添付する形、例えば貼付またはステープラー止めの形をとることができる。さらに無線タグは搭乗券２１に一体的に内蔵する形をとることもできる。
【０００９】搭乗券２１を所持した旅客２０が空港内を、あるゾーンから他のゾーンへと移動すると、新しいゾーンに入るごとにそのゾーン内に設けられている無線

タグ感知装置が搭乗券２１に付されている無線タグからの無線タグ信号を感知し、その無線タグ信号に含まれている無線タグＩＤを認識し、それを自己のゾーンＩＤ及び感知時刻と共に、管理センター等に設けられる旅客管理装置３０に対し送信する。無線タグＩＤは、少なくとも当日の搭乗待ちの個々の旅客を特定できるように例えばＮＨ００１２０００１のように設定される。

【００１０】旅客管理装置３０はデータベース３１を持っており、無線タグ感知装置１１，・・・，１ｎから送信されてくる無線タグＩＤ、ゾーンＩＤおよび感知時刻を図２に示すようなデータ構造をもってデータベース３１に蓄積する。図２の例では、無線タグＩＤをＮＨ０９９１０２５８等とし、感知時刻を１０時１２分５８秒の意味で１０：１２：５８等と表現し、ゾーンＩＤをＺＯＮＥ０１０等と表現している。図２の場合は、各無線タグ感知装置から次々と送信されてくるデータを受信順に蓄積している。データベース３１はさらにゾーンＩＤすなわち無線タグ感知装置の設置ゾーンを表すＩＤと、それに対応する地図情報を持っており、捜索対象の旅客２０のゾーン単位の足取りから現在位置を探る助けにする。

【００１１】旅客管理装置３０には空港の係員４０によって操作される旅客捜索端末４１が接続されている。定刻近くになっても搭乗ゲートに現れない旅客がいるとき、その旅客が所持している搭乗券の無線タグＩＤに旅客捜索端末４１の設置ゾーンを示すゾーンＩＤを付して、当該旅客の捜索要求を旅客捜索端末４１から旅客管理装置３０に対して送信する。これにより、旅客管理装置３０は送信されてきた無線タグＩＤを検索キーとしてデータベース３１を検索し、その検索結果として得られた、捜索対象の旅客のゾーン単位の空港内足取りに関する時系列データを例えば降順ソートして、図３に示すように、ゾーンＩＤと共に旅客捜索端末４１に送信し表示させる。これにより、捜索対象の旅客が空港内にいる限り、その旅客の存在場所をゾーン単位で知ることができる。また、移動履歴を知ることにより、たとえ、最終的に立寄ったと見られるゾーンに旅客がいなくても、足取りの傾向からある程度まで現在の存在場所を推定することができる。このようにして、捜索対象の旅客の足取りを搭乗券付属の無線タグのＩＤを検索キーとしゾーンを単位として捜索することができ、捜索時間を短縮することができる。

【００１２】旅客捜索端末４１は、搭乗ゲート等に据置き設置されるコンピュータ端末であってもよいし、旅客管理装置３０に有線または無線で接続される携帯端末であってもよい。携帯端末とする時は、携帯端末に対し固有の端末ＩＤを付与しておき、旅客管理装置３０に対し捜索要求を送信する時、ゾーンＩＤの代りに、端末ＩＤを用いるようにすればよい。

【００１３】

【発明の効果】本発明によれば、搭乗券に無線タグをつけて、空港内の無線タグ感知装置によってその搭乗券を持つ旅客が空港内のどこをどう移動したか、または移動しなかったを容易に知ることができ、捜索対象の旅客の居場所を限定し、捜索時間を短縮することができる。

【図面の簡単な説明】

【図１】本発明による空港内旅客捜索装置の一実施形態を示すブロック図。

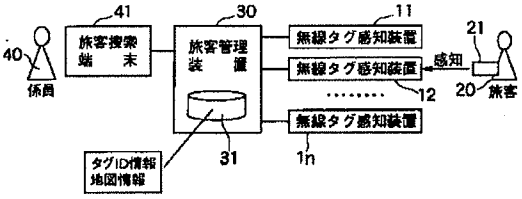
【図２】図１におけるデータベースのデータ構造例を示す図表。

【図３】図１における旅客捜索端末の捜索結果の表示画面例を示す図。

【符号の説明】

１１～１ｎ　無線タグ感知装置
２０　旅客
２１　搭乗券
３０　旅客管理装置
３１　データベース
４０　係員
４１　旅客捜索端末

【図１】



【図２】

無線タグID	感知時刻	ゾーンID
NH09910258	10：12：58	ZONE010
NH00120029	10：12：59	ZONE003
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NH09910258	10：20：34	ZONE011
NH00060308	10：20：34	ZONE042
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感知情報データベース例

【図３】

捜索無線タグID　NH09910258

捜索場所　ZONE013

感知履歴

No.	感知ゾーン	感知時刻
01	ZONE013	10：25
02	ZONE014	10：22
03	ZONE011	10：20
04	ZONE010	10：12

捜索端末の結果表示例

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(51) INT CL[7]
H04Q 7/20 , G08B 1/08 , G08C 21/00 , H04Q 7/00

(52) UK CL (Edition T)
H4L LRPLS

(56) Documents Cited
WO 95/35634 A **WO 00/44184 A**
US 6104295 A **US 6057758 A**
US 6032127 A **US 6011487 A**
US 5214410 A
A WAP (WIRELESS APPLICATION PROTOCOL) MOBILE PHONE
WPI ABSTRACT ACCESSION NO.1995-149241 [20] & FR 002711001 A (PACCHIANI) 14.04.1995

(58) Field of Search
UK CL (Edition S) **H4L LCX LRPLR LRPLS LRPMX**
ONLINE: WPI, EPODOC, JAPIO

(54) Abstract Title
A person or object locating and personal information system

(57) A person or object locating and personal information system operates to provide an approximate position of a person or object within the system's range and also provide an information service to the person being tracked. The systems range is governed by the size of the cellular positioning network(s).

The cellular positioning network(s) determines the location of the electronic tracking devices (These devices being physically associated with the tracked person or object) and communicates this information to the computer(s) or computer network(s) running the computer software program(s) this information is collated, processed, stored, distributed and displayed as required by the user(s).

An information service provider(s) supply the personal information display and interface units with information relevant to the user. This information could be controlled be the user or automated.

The system may be useful in airports to locate baggage or passengers, locating patients in hospitals, locating shoppers in supermarkets or could be applied to many populated social environments.

GB 2 365 683

A PERSON OR OBJECT LOCATING AND PERSONAL INFORMATION SYSTEM

Electronic location systems are well known. Generally systems operate to provide an approximate position of an object within the system's range; this information can then be utilised by the system user.

There are particular systems that require the tracked object to be associated with an element of the location system.

Existing location systems exhibit some of the following features: -

Relevant positioning resolution,

The ability to locate many thousands of people or objects,

Operation inside structures, beneath the ground or in the sea,

Capability of locating moving people or objects,

Economically viable.

However, no current system meets all of the above and can provide the users with a personal information and system.

According to the present invention there is provided a person or object locating and personal information system. The present invention comprises of a computer(s) or computer network(s), computer software program(s), a cellular positioning network(s), a number of electronic tracking devices associated with the tracked person or object, a number of personal information display and interface units and an information service provider(s). The tracking devices may or may not be physically integrated with the personal passenger information units.

A specific embodiment of the invention will now be described by way of example. The example describes the invention being applied in an airport environment.

The airport or area in which tracking is required is divided up into many smaller areas, associated with each area is a node (cell) of the cellular positioning network.

Within the airport or area in which the system operates there are people (passengers or staff) and/or objects (baggage or freight) that are required to be located. Associated with the people (passengers) and/or objects (baggage or freight) are uniquely coded tracking devices (tag), one device per person or object.

Upon a request for the location of a person or object (this request may be either software driven or by the user/operator) the computer(s) or computer network(s) determines the unique identity code relevant to the person or object (the determination of the identity code is either entered into the system by the user, found in the systems database, or calculated via mathematical formula). This data is then communicated via a network of suitable means to the cells.

The cells transmit this unique code (this code is only relevant to one tag in the system) via suitable means e.g. UHF part of the electromagnetic spectrum. This code is received by all of the tags but only the tag that receives an appropriately coded signal will respond.

The response is a transmission, via suitable means of it's own identity code, only local cell(s) will receive this signal due to the fact that the tag transmits at low power and thus the signal does not travel very far. Alternatively the tag would transmit if instructed by the person or object with which it is associated for example if the passenger needs assistance.

The received tag data is communicated via a network of suitable means to a computer(s) or computer network(s) where the data is processed.

The position is determined in two ways i.) Reception of tag signal at one or more cells means the tag is within the operating range of the receiving cell(s) and/or ii.) The tag's signal strength is measured at the receiving cell(s) to determine an approximate range.

This position information is then stored and/or displayed by a suitable means. This information can then be utilised by the user/operator of the system to improve efficiency; in the case of an airport reduce the number of delayed departing flights due to late or lost passengers or baggage.

Together with the locating system there maybe provided a personal information system. This would take the form of a hand held interface unit and display or a body worn unit with a head worn viewing device. This would provide visual and/or audio information which could be passive or interactive e.g. films or Internet as appropriate to the user (passenger). The information required would be transmitted via suitable means and/or stored within the unit itself.

It is also possible that the information gained by the system could be accessible via the Internet.

This is a non-exhaustive example and the system or part system could be applied to many situations. Here follows a brief description of the invention applied to some different environments.

Hospital.

The present invention could also be applied to a hospital environment to locate patients and/or staff and could provide them with visual and/or audio information that could be passive or interactive.

Supermarket

The present invention could also be applied to a supermarket or any large shopping environment to locate shoppers and/or staff and could provide them with visual and/or audio information that could be passive or interactive e.g. location of a product or display of special offer. The information on the route that shoppers take through a supermarket or any large shop would be useful, e.g. to determine optimal product layout.

It is conceivable that the present invention could be applied to many populated social environments, e.g. exhibitions/exhibition centres, museums, sports centres, manufacturing plants, offices, shopping centres etc.

CLAIMS

1 A person or object locating and personal information system comprising a computer(s) or computer network(s), computer software program(s), a cellular positioning network(s), a number of electronic tracking devices associated with the tracked person or object, a number of personal information display and interface units and an information service provider(s). The tracking devices may or may not be physically integrated with the personal passenger information units.

2 A person or object locating and personal information system as claimed in claim 1 wherein the cellular positioning network(s) communicate with the electronic tracking devices via wireless electromagnetic means.

3 A person or object locating and personal information system as claimed in claim 1 wherein personal information display and interface units communicate with the information service provider(s) via an electronic means.

4 A person or object locating and personal information system as claimed in claim 1 wherein the electronic tracking device(s) can be triggered by the user(s) to invoke an action within the person or object locating and personal information system.

5 A person or object locating and personal information system as claimed in claim 1 wherein the users can command the cellular positioning network(s) to communicate with one or many electronic tracking device(s) and invoke an action other than for location purposes.

6 A person or object locating and personal information system as claimed in claim 1 wherein the users can control the information which they receive on the personal information display and interface units.

5.

7 A person or object locating and personal information system substantially as described herein.

INVESTOR IN PEOPLE

Application No: GB 0009820.2 **Examiner:** Chris Archer
Claims searched: 1-6 **Date of search:** 4 December 2001

Patents Act 1977
Search Report under Section 17

Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.S): H4L (LRPLS, LRPLR, LRPMX, LCX)

Int Cl (Ed.7):

Other: ONLINE: WPI, EPODOC, JAPIO

Documents considered to be relevant:

Category	Identity of document and relevant passage		Relevant to claims
X	WO 00/44184 A	(NEOPOINT) see whole document	1-6
X	WO 95/35634 A	(PRICE) see in particular page 10 line 35 to page 11 line 4	1 at least
X	US 6104295	(GAISSER) see whole document	1 at least
X	US 6057758	(DEMPSEY) see in particular column 7 line 20 to column 9 line 9.	1-6
X	US 6032127	(SCHKOLNICK) see in particular column 9 line 66 to column 10 line 47	1-6
X	US 6011487	(PLOCHER) see in particular the abstract	1 at least
X	US 5214410	(VERSTER) see whole document	1-6
X	A WAP (wireless application protocol) mobile phone		1-6
X	WPI abstract accession no. 1995-149241 [20] & FR 2711001 A (PACCHIANI) 14.04.1995 (see abstract)		1 at least

X Document indicating lack of novelty or inventive step
Y Document indicating lack of inventive step if combined with one or more other documents of same category.
A Document indicating technological background and/or state of the art.
P Document published on or after the declared priority date but before the filing date of this invention.
E Patent document published on or after, but with priority date earlier